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Journal of Occupational Medicine

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The manuscript, including references, footnotes, and legends for illustrations, should be typed on one side of a standard-sized page of opaque paper, double-spaced, and with at least a one inch margin at each edge. One carbon copy should accompany the original typescript, and the author should retain a carbon copy for use in reading galley proofs.

The authors' names should be accompanied by the highest academic or medical degrees that they hold; letters indicating membership in honor or professional societies will not be published. Authors who are in the armed services should not use civilian degrees in connection with their names. The city of each author should be supplied, and an address should be provided at the end of the manuscript for the use of readers who may wish to communicate with the senior author. If academic, hospital, or industrial connections are given for one author, they must be given for all other authors who have such connections. The authors are responsible for obtaining permission from the proper authorities to use the names of institutions.

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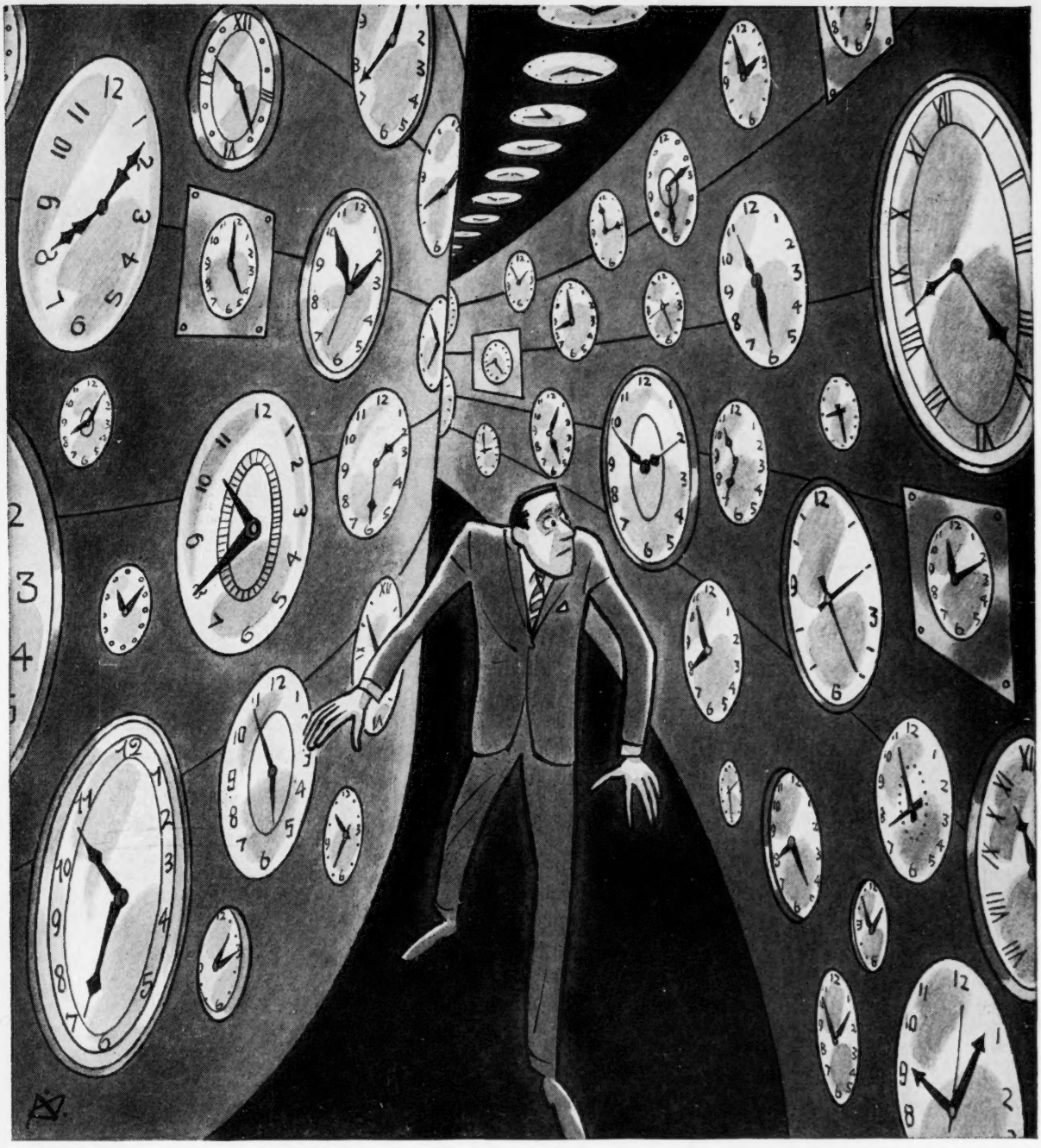

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The Industrial Medical Association was organized in 1915 as the American Association of Industrial Physicians and Surgeons. Its first annual meeting was held the following year. In 1951 the present name was adopted.

The purposes of the organization as stated in the certificate of incorporation (not-for-profit) are:

"The object of this Association will be to foster the study and discussion of the problems peculiar to industrial medicine and surgery; to develop methods adapted to the conservation of health among workers in the industries; to promote a more general understanding of the purposes of the medical care for employees; and to unite into one organization members of the medical profession specializing in industrial medicine and surgery for their mutual advancement in the practice of their profession."

Presently, the membership totals nearly 4000 physicians in the United States, Canada, Latin America, and other parts of the world. Physicians "who have an interest in Industrial Medicine" may apply for membership; specialization in this field is not essential. Regionally, the Industrial Medical Association has 14 Component Societies in the United States. Most Association members carry their membership through one of the component groups.

The Journal of Occupational Medicine, owned and published by the Industrial Medical Association, is sent monthly to each member as one of the advantages of membership.

The annual business meeting and convention is held in the spring. Since 1945, the convention has been held concurrently with the meetings of four other organizations having related interests—American Industrial Hygiene Association, American Conference of Governmental Industrial Hygienists, American Association of Industrial Nurses, Inc., American Association of Industrial Dentists. This combined meeting is known as the Industrial Health Conference.

The Occupational Health Institute, Inc., is a nonprofit educational organization created by the Industrial Medical Association to promote the cause of health in industry. Since 1951, the Occupational Health Institute has conducted the program of evaluation, approval and certification of Medical Services in Industry, on the basis of standards established by the Standards Committee of the Industrial Medical Association. This program was conducted by the American College of Surgeons for many years until its transfer to the Association.

The Association's headquarters office serves as a focal point for the Association's activities, and through its coordination of information regarding industrial health problems encountered throughout the country, it offers invaluable assistance to members on a host of specific subjects.

ANNUAL MEETING & INDUSTRIAL HEALTH CONFERENCE

War Memorial Auditorium, Rochester, N. Y. **April 26 to 29, 1960**

Journal of Occupational Medicine

Convalescence After Surgery

AN INTRODUCTION

F. C. Dohan, M.D., Philadelphia, Pa.

THE MARKED change in the physician's attitude toward the "need" for prolonged postoperative bed rest has resulted in "early ambulation" and considerably shorter periods of hospitalization. However, these changes and the many improvements in surgical care have not resulted in a general decrease in the total duration of convalescence. Why?

This Symposium was designed to define the problem, suggest methods of measurement, and explore some of the factors affecting the total duration of the convalescence period after surgery. The first two papers (Fleming, Saffeir) describe in detail the actual duration of "convalescence" (from surgery to return to work) under varying economic and sociologic conditions. The third paper (Pell) presents methods for processing these and similar data by modern electronic computers. The fourth paper (Moss) presents a review of recent studies of factors affecting the duration of surgical convalescence.

The most important factor in determining the duration of surgical convalescence (after the first week or two) in uncomplicated cases seems to be the doctor's opinion concerning the time needed for convalescence. An unnecessarily prolonged postoperative convalescence period as a result of a physician's advice is a form of "iatrogenic illness." In addition, this results in loss of pay to millions of employed men and women, much inconvenience, additional expense, and in the aggregate an enormous loss to the economy of our country.

Many data, including those demonstrating that men in the Air Force return to "full duty" in less than one-third of the time of men of similar age working in industry, indicate that a radical revision of the physician's concept of the proper duration of postsurgical convalescence is needed. Metabolic and endocrine alterations and the time required for the development of maximal tensile strength of clean wounds do not account for the usual duration of postsurgical convalescence.

Furthermore, the data presented by Saffeir and by Fleming suggest that the prolonged civilian convalescence period is *not* due primarily to the desire of individuals for a partially or totally paid "vacation-convalescence." This is indicated by the lack of correlation of various economic factors with the average duration of convalescence. In addition, the average duration of postsurgical convalescence in the group reported by Fleming is lower than that reported by Saffeir, despite the fact that individuals in the former group received their full wage plus accident and sickness insurance benefits, compared with only partial replacement of lost wages in the group with longer convalescence reported by Saffeir.

The key to the problem appears to be the

Dr. Dohan is from the Department of Medicine, School of Medicine, University of Pennsylvania and is Medical Director for the Radio Corporation of America.

Presented in the Symposium on Convalescence After Surgery at the Forty-Third Annual Meeting of the Industrial Medical Association, Atlantic City, N. J., April 23, 1958.

opinion of the doctor. On the other hand, there is a very wide range of opinions among surgeons as well as among general practitioners and industrial physicians concerning the necessary duration of convalescence in the same hypothetical case. This variation in opinion is presumably due to the lack of adequate criteria and critically evaluated experience with shorter convalescence periods as well as the vague fear that "something might happen to the patient." It also appears that the possibility of improving the rate of convalescence after surgery by directed, gradually increasing activity is a relatively untouched field of practice, despite the experience of the military services during World War II and the increasing interest in rehabilitation in other areas of medical practice. Undoubtedly, more investigations on the physiological and psychological factors involved in the convalescence period are needed.

The benefits to the patient of an improvement in the conduct of the convalescence period are obvious. In addition, the wide sociological implications should make this problem of interest to unions, public health officials, industries and insurance companies, since a decrease in unnecessary illness is of benefit to all.

Dr. Dohan's address is Department of Medicine, School of Medicine, University of Pennsylvania, Philadelphia.

20TH ANNUAL MEETING

of the

AMERICAN FRACTURE ASSOCIATION

will be held

November 1-4, 1959

at

The Roosevelt Hotel, New Orleans

The first day of the meeting will be devoted to an instructional course which has been made acceptable for Category Number I credit by the American Academy of General Practice. The postgraduate division of the School of Medicine of Tulane University will coordinate this program for which a tuition fee will be charged. There will be roundtable luncheon panels covering 15 provocative subjects with limited attendance at each table, and with a Moderator coordinating extemporaneous discussion.

Scientific sessions continue on November 2, 3, and 4. Discussions will not be prepared but will arise extemporaneously from the floor. Two important features of the meeting will be: (1) a session for instructing the topography for external skeletal pinning . . . an important adjunct in fracture therapy either preferred or when all other methods may not be immediately applicable; (2) a discussion in symposium of Ostamer . . . the new plastic for internal fixation of fractures. This is probably the latest development in fracture therapy approach since the advent of intramedullary fixation. Problem cases may be brought for discussion, accompanied by x-rays, during the forum periods.

For further information, write H. W. Wellmerling, M.D., Secretary-General, The American Fracture Association, 610 Griesheim Bldg., Bloomington, Illinois.

Return to Work After Surgery —An Industrial Study

Allan J. Fleming, M.D., Wilmington, Del.

THE MANY advances made in recent years in the preparation of patients for surgery, in anesthesia, blood replacement, control of electrolytes, and in surgical technique, including the control of infection and postoperative care, have shortened hospital stay considerably, despite the complexity of many of today's surgical procedures. Surgical treatment is now available for many conditions, involving particularly the heart and lungs, that seriously reduced the life expectancy of those affected a generation or two ago. New approaches may further modify surgical care by shortening wound healing and convalescence. It was not many years ago that John H. Powers[1] demonstrated the benefit of early postoperative activity in shortening convalescence after surgery. More recently, Ian G. McDonald[2] has advocated exposure-suction treatment for surgical wounds, particularly in radical surgery, to promote more rapid healing of the wound. As a result of such studies, hospital stay is being shortened. During the period from 1945 to 1950, average hospital stays for general surgical operations were shortened by about five days.

The subject of return to work after surgery is of more than passing interest to industry today, for many industries have employee benefit plans that may involve full or partial payment of wages as well as insurance benefits during an employee's absence from work due to illness. In my own company, benefits begin for salaried employees on the first day of disability and for wage-earning employees on the third day of disability. In addition, all employees have accident and health insurance policies that pay benefits beginning on the eighth day of disability and continuing for a maximum period of thirteen weeks. The cost of these benefits is considerable. It is important, therefore, to keep the period of disability in each case to the lowest possible level consistent with good surgical care and employee safety.

The purpose of this industrial study was to determine whether early ambulation, shortened hospital stay, and shortened convalescence after the more common surgical procedures have reduced the period of disability. Comparative data are scant and current welfare plans probably reduce the incentive to return to work quickly below what it would be if income stopped during absence for illness.

The information in this report was obtained from the accident and health insurance claims for nonoccupational illness during 1956 of a company population of some 90,000 employees. Geographically, most of these employees live in the states east of Chicago and north of the southern border of Tennessee and North Carolina. The data were processed by the Biostatistics Section of our Medical Division under the direction of Sidney Pell.

Information from the insurance claims was transferred to a code sheet containing a list of every item of information relevant to this study. This included the cause of disability classified according to the International Statistical Classification of Diseases, the number of days of disability, age, sex, location, and whether the employee received a wage or a salary. Spaces were provided on the code sheet to enter the information in the form of a punch-card code. The information from the code sheets was then transferred to punch cards by a key-

Dr. Fleming is Medical Director, E. I. du Pont de Nemours & Company, Inc.

Presented in the Symposium on Convalescence After Surgery at the Forty-Third Annual Meeting of the Industrial Medical Association, Atlantic City, N. J., April 23, 1958.

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TABLE I—COMPARISON OF DISABILITY FOR APPENDECTOMY AND HERNIOPLASTY
Mean calendar days absent

References	Period	Worker group	Appendectomy			Herniorrhaphy		Population studied
			Male	Female	No. cases	Male	No. cases	
Brundage[3]	1915-24	Mixed	30.8	43.6	184	—	—	1950-3,000
Brundage[4]	1921-22	Auto (Flint)	47.0	—	104	55.6	40	21,000
	1921-22	Auto (Pontiac)	35.7	—	78	49.1	36	
Brundage[5]	1924	Industrial	48.8	—	72	53.3	31	114,065
Gafafer[6]	1940-46	Industrial	42.9		2,542	55.4	1,324	133,000
Powers[1]	1944	Mixed	33.6	(M. & F.)	22	39.2	78	100
	1956 Du P.	Wage roll	30.3	26.2	376	40.1	518	90,000
	Du P.	Salary roll	25.0	29.0		32.0		

punch operator. The cards were verified for accuracy and then sent to one of the company's electronic computers for processing.

The first step in the processing of the data was the transfer of the information on the cards to tape by means of a card-to-tape converter. Three tapes, known as input tapes, were required for the processing: one tape containing the medical and personal information obtained from the insurance claim, which was transferred from the punch cards; a second, containing the company population and the population of each department and each location broken down by age, sex, and salary or payroll classification, for the computation of illness rates; a third, containing instructions to the machine on how the information on the other two tapes was to be processed.

The computer utilized these three tapes to perform all the necessary computations and to arrange the results in the sequence desired for the report. The data so processed were transferred to output tapes, which were fed into a high-speed printer that prints each sheet of tabulations in from two to six seconds. These statistics have furnished some indication of the degree of association of length of convalescence following surgery to age, sex, occupation, and geographical location.

Table I shows the mean days of disability for two common operations, appendectomy and herniorrhaphy, on which data have been recorded over a period of about 40 years, largely with reference to male employees. It is interesting that the average number of days lost following appendectomy by male workers between 1915 and 1924 is almost the same as the average number of days lost by our wage-earning group in 1956. Our 1956 experience with days lost following appendectomy and herniorrhaphy compares favorably with the series reported by Powers in 1944 with his emphasis on the abuse of rest as a therapeutic measure following surgery.

As indicated in Table I, other series reported between 1921 and 1946 show far more days of disability following both appendectomy and herniorrhaphy than either the 1944 series reported by Powers or our own 1956 series. If our data are typical for these two operations, it would appear that improved surgical technique, early mobilization, and in-plant medical

TABLE II—DISABILITY FOLLOWING SURGERY IN DAYS (1956)

	No. cases	Mean	S.D.	C.V.
Appendectomy	376	28.6	12.9	45.1
Hernia of abdominal cavity	518	37.6	16.3	43.3
Pilonidal cyst	116	27.2	11.4	41.7
Hemorrhoidectomy	432	25.2	9.9	39.1
Tonsillectomy	269	15.4	6.3	41.1
Anal fissure and fistula	121	26.3	12.6	48.0

TABLE III—MEAN AND STANDARD DEVIATION OF NUMBER OF DAYS OF DISABILITY BY SEX AND PAYROLL CLASS (1956)

	Mean	Standard deviation	No. of cases
Hemorrhoidectomy			
Male wage	26.1	9.4	275
Male salary	22.8	8.9	104
Female wage	26.1	13.3	40
Female salary	22.8	11.7	13
Appendectomy			
Male wage	30.3	14.4	232
Male salary	25.0	10.0	87
Female wage	26.2	8.7	32
Female salary	29.0	8.0	25
Herniorrhaphy			
Male wage	40.1	15.6	351
Male salary	32.0	16.8	157
Female wage	42.0	17.0	5
Female salary	34.4	11.0	5
Displacement of intervertebral disc treated surgically			
Male wage	86.7	25.6	67
Male salary	76.3	34.2	8

supervision have resulted in earlier return to work, despite the fact that loss of income is no longer an important incentive to return to work early.

Table II lists the days of disability following surgery for six common conditions. The cases reported include males and females, as well as salaried and wage-earning employees.

As might be expected, there is a considerable difference in the mean days of disability and the standard deviation of the mean for the operations listed in Table II. However, the numerical similarity of the coefficients of variation suggests that the unmeasurable factors operating to produce variations in the period of disability are not only constant, but also independent of the operation performed. This implies that the period of disability may depend more on the patient than it does on either the surgeon or the type of operation performed. Our data show that the mean period of disability for the operations listed in Table II is about the same, irrespective of the part of the country in which the surgery is performed.

Table III shows that males tend to lose less time than females after similar operations and that salaried employees lose less time than wage-earning employees. It has been reported[6] that disability following surgery is longer for those more than 50 years old than it is for those less than 50. Our experience at present indicates relatively little association between age and the length of disability in a population between 20 and 65 years of age.

TABLE IV—RELATION OF DAYS OF DISABILITY TO DAYS OF HOSPITALIZATION

	Range of Days in Hospital	Range of Days of Disability
Herniorrhaphy	5-10	20-80
Appendectomy	3-7	10-43
Hemorrhoidectomy	4-10	12-38
Surgical disc	10-36	40-150

If the trend to shorter hospital stay following surgery is definite, one would expect it to be reflected in earlier return to work, but this does not seem to be the case. Scatter charts show no correlation between the number of days in the hospital and the number of days of disability, following appendectomy (Fig. 1), herniorrhaphy (Fig. 2), hemorrhoidectomy (Fig. 3), and intervertebral disc (Fig. 4).

Why there should be no correlation is not clear. Perhaps it has become the custom for surgeons to send the patient home from the hospital early, leaving to the general practitioner further postoperative care, and the decision as to when the patient may return to work.

The range of days in the hospital and the range of disability for four operations is indicated in Table IV.

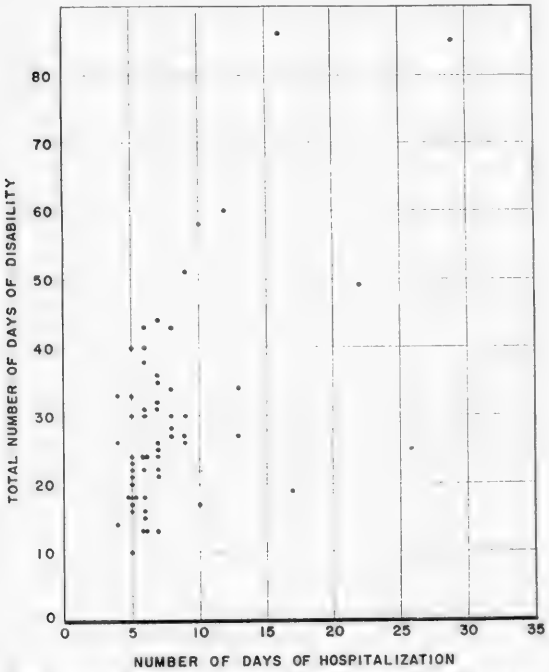

Fig. 1—Scatter chart showing relation of total number of days of disability to number of days of hospitalization for appendectomy.

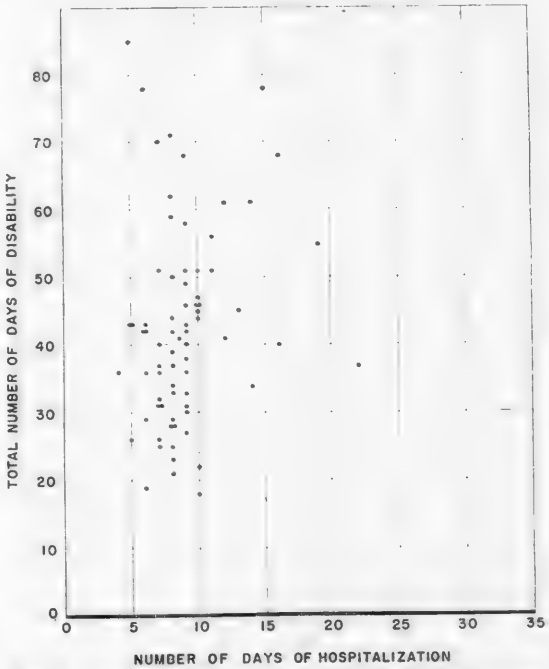

Fig. 2—Scatter chart showing relation of total number of days of disability to number of days of hospitalization for herniorrhaphy.

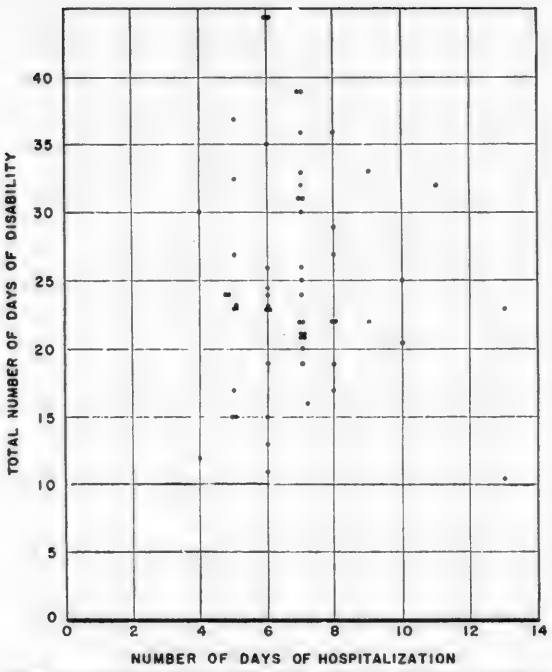

Fig. 3—Scatter chart showing relation of total number of days of disability to number of days of hospitalization for hemorrhoidectomy.

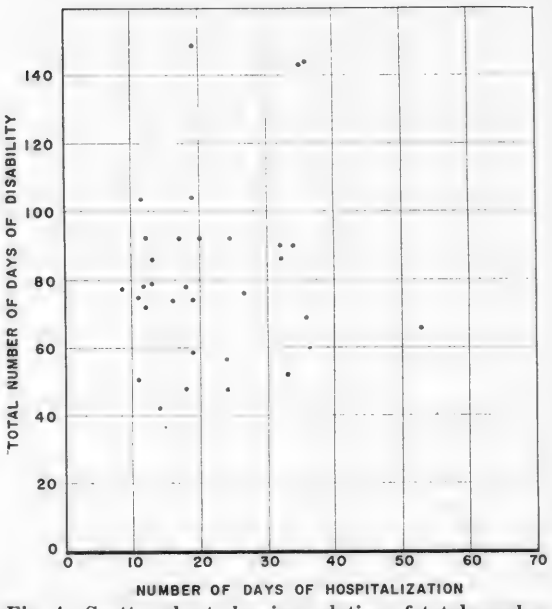

Fig. 4—Scatter chart showing relation of total number of days of disability to number of days of hospitalization for intervertebral disc.

We feel that our experience with respect to disability following surgery is favorable; at least, we have been told that this is so by accident and health insurance carriers. In part, I think this can be attributed to the close attention and supervision given to disability by our physicians in various plants across the country. One aspect of their work is to know the requirements of each job in a plant, and they are in an excellent position to advise whether an employee is fit to return to his job. If the plant physician entertains any doubts, he consults the surgeon further, before deciding.

In conclusion, our findings indicate that the period of convalescence after surgery is influenced by sex and payroll classification, but that it is not influenced by the geographical distribution of employees or by the length of stay in the hospital following surgery.

To assess the influence of the surgeon in the variation of surgical disability it would be necessary to study an appreciable number of cases treated by the same group of surgeons to determine how disability is influenced by individual surgical practice.

I make one plea to surgeons. When you are satisfied concerning the surgical recovery of a patient, leave the decision as to return to work to the plant physician, if the patient's company has one.

A well-trained and experienced industrial physician knows the nature of the employee's job and is better able to judge whether the employee should go back to full-time, or part-time work, or be assigned temporarily to another job. The addition of another two-week period of convalescence merely for the sake of safety can often be avoided by so doing. Keeping people gainfully employed is our job. An unnecessary extension of convalescence is waste, and today, the price of waste is high.

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The Duration of Surgical Convalescence as Indicated by Insurance Statistics

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MY FIRM, The Travelers Insurance Company, and many other accident and health underwriters offer a group insurance coverage which is generally referred to in the industry as weekly indemnity. This coverage provides for the payment of a weekly income when an insured becomes disabled. This income usually does not start until after a short waiting period and continues for the period of disability up to a maximum of three months, six months, or a year, depending on the plan purchased.

Whenever a claim is incurred, we prepare a punch card which contains identifying information and certain statistics important for our internal accounting use. Occasionally we make a special claim study to see if there have been any changes in particular claim characteristics. For this purpose a sample of our claims is coded more thoroughly so that we will have information regarding the cause of disability, whether or not there was surgery, the date surgery was performed, the duration of disablement, the amount of disability income, the wage, where the disability took place, and so on. The information is then converted to punch cards. It is from such a sample that the information in this paper is derived.

We have selected three of the most common surgical procedures for our study before this group; these are appendectomy, herniorrhaphy, and hemorrhoidectomy. All procedures in this sample occurred in 1957. I might mention at this point that we have prepared detailed analysis of our male claims only. We have done this because the female data are relatively sparse owing to the fact that our group policies cover employee groups which are about three-quarters male and one-quarter female.

Let us examine male hemorrhoidectomies first. There was a considerable range in the duration of surgical convalescence, the most common duration being three weeks. The range was from 3 days to 14 weeks, and the average stay was 4 weeks. The same wide range is present in herniorrhaphies. The most common duration is 6 weeks, the average duration was 6½ weeks, and the range was from 7 days to 15 weeks. Appendectomies show a similar variation in duration. The average duration is 5 weeks, the most common duration is 3½ weeks, and the range is from 8 days to 14 weeks.

An analysis of the statistics available to us indicates that the female surgical convalescence durations have a range at least as wide as those of the males. We have also found that the average length of surgical convalescence is significantly higher for females than for males. Our studies indicate that the duration of female surgical convalescence for appendectomy is about 15% longer than for male, about 40% longer for herniorrhaphy, and about 30% longer for hemorrhoidectomy.

Why should there be such variations in the duration of surgical convalescence such that one person stays out of work for 2 weeks and another for 10 weeks? There are certain influences difficult to measure in a study of this sort. One of these is the desire of the employee to return to work because of a sense of responsibility, liking for the work, etc. We were unable to investigate this point directly, although we do have certain indirect data. A second feature which we were unable to pursue in this study was the effect of light labor or heavy labor on duration. In a previous investigation we separated a claim sample of one procedure into those for persons doing light labor and those doing heavy labor. Those in heavy labor had a surgi-

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cal convalescence 50% longer than those in light labor.

There are, however, certain influences which can be measured directly from our statistics. These include age, personal economic factors, and geographical region. Let us consider the effect of age on the duration of surgical convalescence. We would expect that the duration of surgical convalescence would increase with advancing age. To what extent this is true? With respect to hemorrhoidectomy it appears that the variation in the average duration is from roughly 22 days at age 25 to approximately 30 days at age 65, a difference of about a week. Turning now to herniorrhaphies, the average ranges from approximately 42 days at age 25 to roughly 50 days at age 65, again about a week's difference. For appendectomies, the average ranges from 37 or so days at age 25 to roughly 45 days at age 65, again a range of about a week. This indicates that there is an upward trend in the duration of surgical convalescence as the age advances. However, the differences in duration by age, while significant, are not sufficient in themselves to explain the very wide difference in surgical convalescence duration mentioned previously.

Earlier I suggested that personal economic factors might influence the duration of surgical convalescence. One might believe that as the amount of sickness income increases, there would be a tendency for the employee to remain away from work for a longer time. Our hemorrhoidectomy data indicate that there is hardly any change as sickness income increases. Our herniorrhaphy claims indicates that there is no increase as we go from lower weekly sickness income to higher weekly sickness income. If there is a trend at all, it is downward. Our appendectomy information seems to indicate that the duration falls as the amount of weekly sickness income increases. On the whole, if we consider these three procedures, it appears that the duration of surgical convalescence does not increase and may decrease slightly as the amount of weekly sickness income increases.

Since weekly indemnity is usually a percentage of wage, this slight decrease suggested to us that perhaps there was a tendency for more highly paid employees to return to work sooner than the employees with lower wages. We, therefore, studied the relationship between the duration of surgical convalescence and the amount of weekly wage. We divided those claims where salary information was furnished into three classes: a low wage group, those earning less than $70 a week; an average wage group, those earning from $70 to $90 a week; and a higher wage group, those earning $90 and more. The most interesting thing is that there seems to be no relation between the duration of surgical convalescence and the amount of weekly wage. For example, for hemorrhoidectomies we find that the average duration is between 27 and 29 days for each of the three wage groups. For herniorrhaphies the the average duration of convalescence by wage group ranges from 45 days to 47 days. The appendectomies range from 36 days to 38 days.

We next looked at our claims to see if there was any relationship between the duration of surgical convalescence and percentage of salary being replaced by the weekly indemnity. There were no trends that were apparent.

It seems, therefore, from what we have seen above that personal economic factors—that is, sickness income, the wage, and the relationship between the two—have very little influence on the duration of surgical convalescence.

Perhaps the wide variations in the duration of surgical convalescence which we have noted can be related to the medical costs in the various sections of the country. We divided our data into five medical cost regions which we called A, B, C, D, and E. A is the lowest cost area and E the highest. Area A, for example, included the low medical cost states of Mississippi, Alabama, Georgia, South Carolina, and Arkansas; Area C contains Illinois, Indiana, New Jersey, Ohio, among others, and Area E, with the highest costs, contains Rhode Island, California, Oregon, and Washington. Turning to the appendectomies, we found the range from A to E to be fairly wide. On the whole it seems that there is an upward trend in duration of appendectomy convalescence as medical care costs increase. The herniorrhaphy and hemorrhoidectomy data were similar, and so for the three procedures it appeared as if there were an increase in duration as the medical costs increase. This tendency may be due to several different factors, of which the medical care costs are merely an index. The increase by area, however, generally is only of the order of a few days, and cost area alone certainly cannot explain the wide variations we have discussed.

Let us recapitulate: We have seen that there is a very wide variation in the duration of surgical convalescence. We have seen that increased age has some effect on the duration. The amount of sickness income, the wage of the employee and the relationship between the two seems to be of little or no significance. The medical cost area seems to be of some importance. It would therefore appear that influences other than those just mentioned have a significant effect on the wide variations in the duration of surgical convalescence.

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Electronic Processing of Industrial Medical Data

With Special Reference to "Surgical Convalescence" Statistics

Sidney Pell, Ph.D., Wilmington, Delaware

INFORMATION concerning the health of industrial employees has been accumulating rapidly in recent years as a result of the expansion of industrial medical programs and the widening scope of employee health benefit plans. The records maintained for these programs are intended primarily for clinical or administrative purposes, but they have great potential value as raw material for various types of research, such as investigations into the relation of occupation to health, absenteeism and its causes, and the epidemiology of chronic disease. The data may also be used by the company's medical department to evaluate its activities and to provide a basis for the formulation of additional programs.

Electronic processing of these data may be available to medical departments whose parent organization has rented or purchased an electronic computer for accounting purposes or to aid in the solution of production and distribution problems. It should be understood, however, that the range of problems appropriate for electronic processing is limited by two major cost factors. One is the cost of utilizing the computer, and the other is the cost of programming. The computer program is a set of instructions which tell the computer how to sort the information, what calculations to make, and in what sequence the calculations are to be arranged for tabular presentation in the printed report. The cost of programming can be very high when the calculations are complex and the data are subjected to very detailed analysis. It is necessary to decide whether the nature of the project and the information to be obtained justify these costs.

There are no ironclad rules which one may use to arrive at such a decision; each project must be evaluated individually. Nevertheless, there are certain conditions under which the analysis of the data would tend to be more

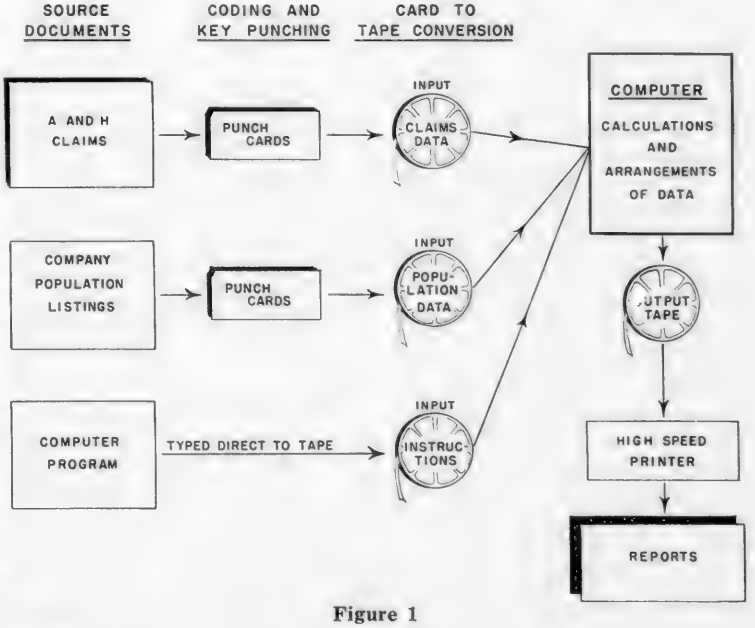

Figure 1

Presented in the Symposium on Convalescence After Surgery at the Forty-Third Annual Meeting of the Industrial Medical Association, Atlantic City, N. J., April 23, 1958.

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MEAN, STANDARD DEVIATION, AND COEFFICIENT OF VARIATION OF NUMBER OF DAYS OF DISABILITY 1956

SELECTED CAUSE... COMPANY AND EACH LOCATI...

PLANT	540 ULCER OF THE STOMACH				541 ULCER OF THE DUODENUM				550-553 APPENDICITIS				560-561 HERNIA OF ABDOMINAL CAVITY			
	CASES	MEAN	S.D.	C.V.	CASES	MEAN	S.D.	C.V.	CASES	MEAN	S.D.	C.V.	CASES	MEAN	S.D.	C.V.
NE	0	0	0	0	3	24.3	21.4	87.9	4	35.5	4.2	11.8	4	44.8	12.1	27.
NE	0	0	0	0	5	39.8	24.4	61.2	3	38.0	14.2	37.3	8	40.3	14.3	35.
NI	7	32.7	15.5	47.5	8	46.6	22.4	48.0	4	25.3	6.1	24.3	8	50.4	22.5	44.
OL	3	31.7	19.4	61.3	7	22.1	15.1	68.1	7	25.4	4.5	17.9	7	26.9	4.9	18.
OL	4	23.3	16.0	68.9	16	36.6	25.9	70.8	12	31.5	10.4	33.0	20	36.2	7.4	20.
PA	2	45.5	53.0	116.5	1	32	0	0	1	44	0	0	3	36.0	1.7	4.
PA	5	35.8	26.7	74.5	6	42.3	16.0	37.8	5	30.2	12.3	40.7	6	52.8	41.0	77.
PE	0	0	0	0	2	29.5	9.2	31.2	1	35	0	0	1	33	0	0
PH	2	41.0	17.0	41.4	6	51.3	17.0	33.1	2	33.0	8.5	25.7	8	41.9	14.4	34.
PO	1	89	0	0	1	12	0	0	3	36.3	3.1	8.4	2	42.0	0	
PO	0	0	0	0	3	47.0	44.3	94.3	3	32.3	.6	1.8	1	65	0	
RE	1	28	0	0	7	52.0	19.4	37.3	3	61.0	21.0	34.4	7	68.4	30.7	44.
RO	0	0	0	0	0	0	0	0	1	36	0	0	8	55.4	13.7	24.
SA	5	44.2	16.8	38.1	8	34.4	34.3	99.7	16	27.6	4.3	15.4	11	36.5	11.5	31.
SA	10	36.9	26.2	71.1	35	24.2	15.3	63.4	63	20.4	8.1	39.6	67	24.2	4.9	20.
SE	4	34.0	16.2	47.5	7	21.9	12.6	57.6	11	36.8	10.6	28.9	11	48.3	10.2	21.
SE	1	34	0	0	1	21	0	0	5	36.8	12.4	33.6	5	59.2	10.6	17.
SP	4	30.8	11.8	38.3	8	19.8	7.0	35.5	4	30.3	11.4	37.8	7	30.6	6.1	19.
SP	1	150	0	0	10	62.1	46.7	75.3	10	27.5	7.6	27.5	10	38.7	7.4	19.
TO	1	27	0	0	0	0	0	0	1	25	0	0	4	61.0	28.4	46.
VI	1	13	0	0	1	15	0	0	3	18.3	3.1	16.7	1	21	0	
WA	1	14	0	0	1	18	0	0	2	33.0	18.4	55.7	6	39.3	12.6	32.
WA	3	24.7	13.6	55.1	6	27.8	10.9	39.1	6	27.2	3.6	13.1	15	39.5	16.4	41.
WI	0	0	0	0	5	32.8	16.7	50.8	0	0	0	0	2	36.0	11.3	31.
YE	2	85.5	91.2	106.7	12	50.8	42.3	83.3	3	25.7	13.1	50.8	6	54.8	7.9	14.
BU	0	0	0	0	0	0	0	0	0	0	0	0	1	34	0	
CH	0	0	0	0	1	25	0	0	6	32.2	26.2	81.4	3	25.0	9.5	38.
EA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
EX	0	0	0	0	0	0	0	0	0	0	0	0	1	21	0	
JA	0	0	0	0	0	0	0	0	2	26.0	2.8	10.9	0	0	0	

Figure 2

efficiently and economically performed by an electronic computer than by conventional methods.

One of these conditions is the processing of a large volume of data. This is a favorable but not always necessary condition. Generally, the importance of volume is inversely related to the complexity of the analysis. Another is frequent repetition of the same type of computations. This is particularly important when the computations require elaborate programming, because the more costly the programming, the more frequently must it be applied to calculations to offset its cost and to yield savings. And a third condition is an analytical program which leans more heavily on statistical computations than on sorting and tabulation. Although, these latter procedures can be performed very quickly and efficiently by an electronic computer, they consume costly machine time without utilizing much of the computer's enormous capabilities. Thus, all preliminary sorting should be done on punch card equipment.

To illustrate how effectively an electronic computer can be used to process industrial medical data, we will refer to our own study of prolonged sickness absenteeism. Data for this study are obtained from claims filed under the Company's group accident and health insurance plan, which provides benefits for nonoccupational illness or injury causing disability of eight or more days. The information on the claim that we use for our study consists of the following: the cause of disability; the number of days of disability; the number of days of hospitalization, if any; whether or not surgery was performed; the kind of accident, if one occurred; and the employee's age, sex, occupation (i.e., production or salaried), and the company installation at which he is employed.

The processing of the data involves the computation of annual incidence rates of sickness absenteeism and various analyses of the num-

A=DAYS AT 40.8=SLOPE.
B=ERROR OF SLOPE.
1=UNDER 40.2=40 AND UP.

RELATIONSHIP BETWEEN AGE GROUPS (UNDER 40 AND 40-AND-OVER) AND NO. OF DAYS DISABILITY BY SEX AND PAYROLL STATUS
1956

SELECTED CAUSES
COMPANY

CAUSE OF DISABILITY	ALL EMPLOYEES			MALE WAGE			MALE SALARY			FEMALE WAGE			FEMALE SALARY		
	A	B1 SB1	B2 SB2	A	B1 SB1	B2 SB2	A	B1 SB1	B2 SB2	A	B1 SB1	B2 SB2	A	B1 SB1	B2 SB2
APPENDICITIS 550-553	30.4	.4 9.9	.5 37.2	35.1	.6 18.2	.6 42.5	22.0	.1 4.2	.6 39.9	35.0	.7 12.2	.6 999.9	28.4	.1 1.7	1.1 211.9
HERNIA OF ABDOMINAL CAVITY 560-561	36.7	.4 20.3	.4 27.3	39.6	.4 22.1	.4 27.7	32.3	.7 29.2	.5 33.5	86.0	4.0 999.9	.4 27.7	999.9	999.9 999.9	1.0 48.2
GASTRITIS AND DUODENITIS 543	21.8	.6 11.5	0 1.5	23.4	.7 - .1 13.0	1.3	6.2 - .9 88.3	.7 25.9		11.9	0 - .4 .8	8.3	999.9 - 1.4 999.9		.8 999.9
GASTRO-ENTERITIS AND COLITIS 571.1	14.6	0 2.1	0 2.5	13.5 - .2 .3		.1 4.3	16.3	.2 - .4 7.7	.9	15.5	0 - .2 4.0	5.5	21.0	.4 - .5 4.9	18.0
ANAL FISSURE AND FISTULA 574	24.6	0 4.3	.5 24.6	24.4 - .3 1.3		.6 23.6	21.9	.4 26.2	.3 21.2	22.8 - .1 .9		999.9 999.9	33.5	.2 128.5	999.9 999.9
GALL BLADDER DISEASE 584-586	57.5	2.6 259.3	.2 32.4	58.3	2.2 264.2	.2 31.0	51.2	2.9 237.1	.9 65.2	59.9	1.8 217.0	.2 74.0	94.9	7.2 - .6 999.9	93.7
CALCULI OF KIDNEY AND URETER 602	22.6	.1 11.6	.3 22.6	23.2	.2 16.5	.2 17.3	28.4	1.2 59.6	.5 27.6	17.1 - .8 .2		0 0	999.9 - 2.7 238.7		2.5 999.9
SPONTANEOUS ABORTION 650.0	25.2	.3 7.7	-10.0 999.9	0	0 0	0 0	0	0 0	0 0	21.3	.1 4.3	0 0	30.2	.5 11.7	-10.0 999.9
ARTHRITIS AND RHEUMATISM 720-727	20.1 - .4 16.2		.7 53.0	17.6 - .8 5.1		.7 52.9	18.6	.4 10.0	2.5 129.3	11.9 - .6 1.3		1.4 24.4	159.5	8.2 999.9	1.4 124.1
DISPLACEMENT- INTERVERTEBRAL DISC 735	48.3	0 - .3 49.9	10.9	44.4 - .8 4.3		.3 8.3	21.3 - 1.0 23.3		.5 72.6	133.7	7.3 858.7	.7 39.1	91.8	4.1 - 3.6 130.0	158.6
AFFECTION OF THE SACRO-ILIAC JOINT 736	22.9	.3 16.9	0 8.8	23.3	.3 20.5	.2 12.6	21.9	.5 - .2 13.0	2.6	16.9	.2 - 2.1 4.0	135.3	38.4	1.1 - 4.7 55.5	999.9
SYNOVITIS AND BURSITIS 741	17.9	0 3.6	.1 5.4	17.8 - .3 .6		0 4.7	16.0	.4 - .1 4.4	.3	20.2	.2 8.2	1.4 104.1	13.1	.1 26.8	.1 1.0
ACCIDENTS, POISONINGS, VIOLENCE 800-999	29.9	.1 24.0	.8 59.7	27.2 - .2 19.0		.4 41.2	40.2	.6 44.5	.8 61.0	32.2	.4 27.1	1.2 104.2	34.2	.6 30.1	2.7 187.2

Figure 3

ber of days of disability, such as frequency distributions, means, standard deviations, and estimates of regression parameters. All of these computations are furnished for each of 31 selected causes of disability by age, sex, occupation, and company location. Figure 1 illustrates the steps that are involved in the entire processing of the data. Three major categories of source documents are required for processing. One of these consists of the original insurance claims. A second contains employee population statistics by age, sex, and occupation for the company as a whole and for each of 68 major company installations. These figures are needed by the computer for the calculation of absence rates. The third category is the computer program.

Each week, we receive copies of new claims and transfer the pertinent information to punch cards. After we record all claims that originated during the previous calendar year, we send the punch cards to the computer installation, where the information on the cards is transferred to tape by a card-to-tape converter, at a rate of 240 cards per minute. The company population data and the computer program are also put onto tape. The program tape is the only one that does not change from year to year. It is kept on file as a permanent set of instructions, and revised only when it is desired to make some alterations in the contents of the reports.

Upon instructions from the program tape, the computer performs all of the required calculations. It also arranges the calculations in a predetermined sequence and order. The results are recorded on several output tapes. These tapes are placed onto the high speed printer, which in turn, produces the finished reports.

A reproduction of a table produced by the high speed printer is shown in Figure 2. This table is part of a report which analyzes the number of days of disability in the company as a whole and in each company installation for each of 31 selected causes. The first column under each illness classification shows the number of cases; the second column, the mean number of days; the third column, the standard deviation; and the fourth column, the coefficient

of variation. Note that the computer furnishes a title for the table and the headings for the columns and rows. All of the digits and letters on each line are printed simultaneously at the rate of 10 lines per second. The table shown here was produced by the high speed printer in about five seconds.

The table seen in Figure 3 shows the findings of a regression analysis that was done to study the relationship between age and number of days of disability. The computer fitted linear regression curves to these two variables. Two lines were fitted for each illness classification: one for employees under 40 years of age, and the other for employees from 40 to 65 years of age. The table furnished all the statistics that are needed for a linear regression analysis. They are the intercept of the line at age 40, the slope of the line, and the standard error of the slope. A significant relationship between age and number of days of disability would be indicated if the slope of the line was at least twice its standard error. In our figures, the slope of the line fitted for each illness category is much less than its standard error. From this, we infer that, in our company, which comprises a working population between 17 and 65 years, age is a minor factor in the determination of length of disability. For example, in the table shown here, a straight line fitted for appendectomy cases under 40 years has a slope of 0.4. The standard error of this slope is 9.9. From 40 to 65 years, the slope is 0.5 and its standard error, 37.2. A low degree of association between age and length of disability was also seen in herniorrhaphies, tonsillectomies, disc surgery, and hemorrhoidectomies.

Before our data were processed by the computer, estimates were made of the cost and time involved in processing data for a single year by means of punch card sorters and table calculators. The time estimate for performing all of the required operations was 2,303 man-hours, whereas the time utilized by the computer is only about eight hours. Furthermore, the computer furnishes the information at less than one-third the cost. It is important to note that the savings in time are much greater than the savings in cost. While the time required by the computer is about 1/300 that of conventional methods, the cost of the computer is only about 1/3.

In addition to substantial savings in time and costs, the computer has other important advantages for which no specific monetary value can be designated.

First, it eliminates the monotony of performing thousands of similar calculations by hand methods. Secondly, it increases accuracy by repeating each series of calculations independently; that is by using different circuits. Thirdly, it frees personnel and machines for other projects. If the computer were not available to us, three persons in our department would have to devote at least three months each year to the processing of our data on prolonged sickness absenteeism. Fourth, the rapidity with which the reports are furnished enables one to make decisions and take any necessary action without prolonged delay. And, finally, the ability of the computer to perform highly complex calculations in a short space of time permits the researcher to enlarge the scope of his analysis of the data well beyond the limits encountered when conventional methods are used.

The author acknowledges with thanks the assistance of Mr. Ralph Reath in the preparation of this paper.

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47TH NATIONAL SAFETY CONGRESS AND EXPOSITION

will be held

October 19-23, 1959

Chicago, Illinois

Headquarters and the exhibits will be at The Conrad Hilton Hotel. A session entitled "Industrial Medical Programs: Their Deficiencies and Excesses" will be held on October 22. This session is co-sponsored by the Industrial Medical Association, the Occupational Health Nursing Section of the National Safety Council, and the American Society of Safety Engineers. For a preliminary program, write: National Safety Council, 425 North Michigan Ave., Chicago 11.

Current Concepts Concerning Surgical Convalescence

N. Henry Moss, M.D., Philadelphia, Penna.

THERE IS increasing evidence that uncomplicated surgical convalescence is unduly prolonged in current civilian practice. Among the factors to account for this is the fact that no adequate criteria have ever been established for the optimum duration of postoperative convalescence in uncomplicated cases. Management of patients in the latter phases of surgical convalescence has been based upon traditional impressions and vague concepts rather than objectively supported evidence. This has been confirmed by a search of the literature, by the wide diversity of opinion expressed by physicians in a recent questionnaire survey,[1] and by informal discussions with many physicians and surgeons. Beck[2] is among the recent pioneers who have conducted studies on this subject.

In order to explore the many factors influencing the total duration of the convalescence period after surgery, a conference* was held in 1958 and a monograph[3] published of the proceedings. The purpose of this report is to review some highlights of that Conference as well as to present recent studies regarding the important role which physician opinion plays in determining the total duration of convalescence after surgery.

Ravdin,[3] emphasizing our need for critically evaluating our concepts of the conduct and duration of the postsurgical convalescence period, traced the historical aspects of the problem and urged that we establish standards somewhere in between the wide swings of the pendulum that have characterized our traditional thinking in the past. Moore[3, 4] and Hardy[3, 5] have each reviewed the metabolic and neuroendocrine changes following surgery and correlated these changes to phases of recovery of the patient. These and many other reports[6-10] substantiate the concept that the metabolic changes do not adequately explain the prolonged average duration of uncomplicated convalescence now customary in civilian practice.

Wound Healing

A study of the rate of wound healing in relation to duration of surgical convalescence reveals that the tensile strength of clean incised wounds return to normal in uncomplicated cases in much shorter periods of time than the average current duration of uncomplicated post-

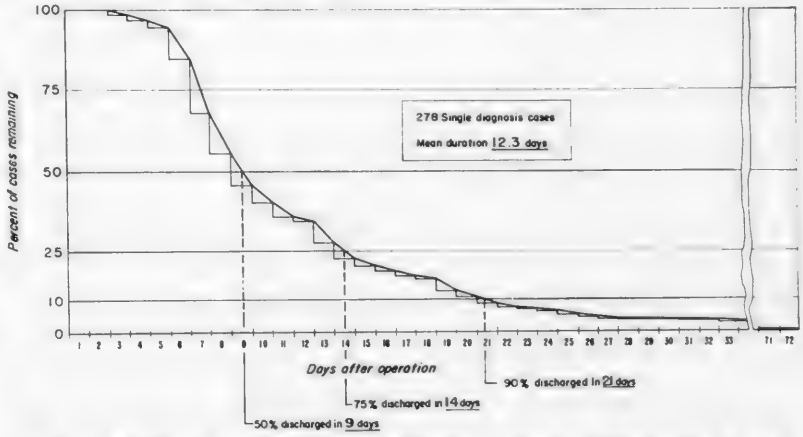

Fig. 1—Return to "full duty" from hospital following appendectomy in Air Force personnel. [Reproduced by permission of Col. David Gold (MC), U.S.A.F.]

Dr. Moss is Adjunct Attending Surgeon and Cancer Coordinator, Albert Einstein Medical Center, and Instructor in Surgery, University of Pennsylvania School of Medicine.

Presented in the Symposium on Convalescence After Surgery at the Forty-Third Annual Meeting of the Industrial Medical Association, Atlantic City, N. J., April 23, 1958.

*Conference on Surgical Convalescence held under the auspices of the American College of Surgeons and the New York Academy of Sciences on March 7 and 8, 1958.

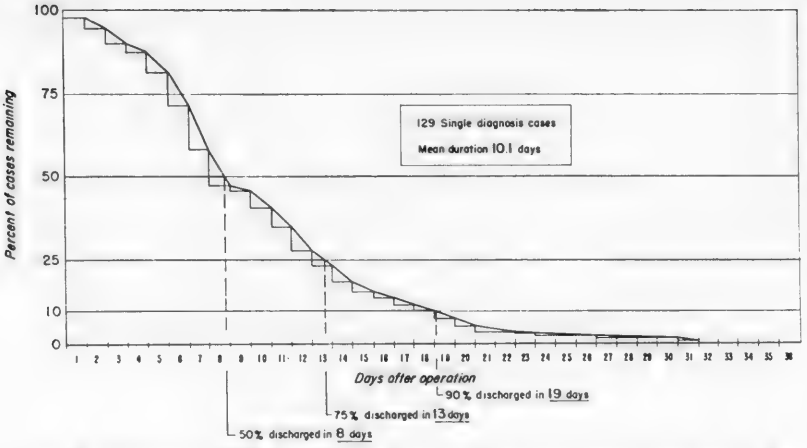

Fig. 2—Return to "full duty" from hospital following hemorrhoidectomy in Air Force personnel. [Reproduced by permission of Col. David Gold (MC), U.S.A.F.]

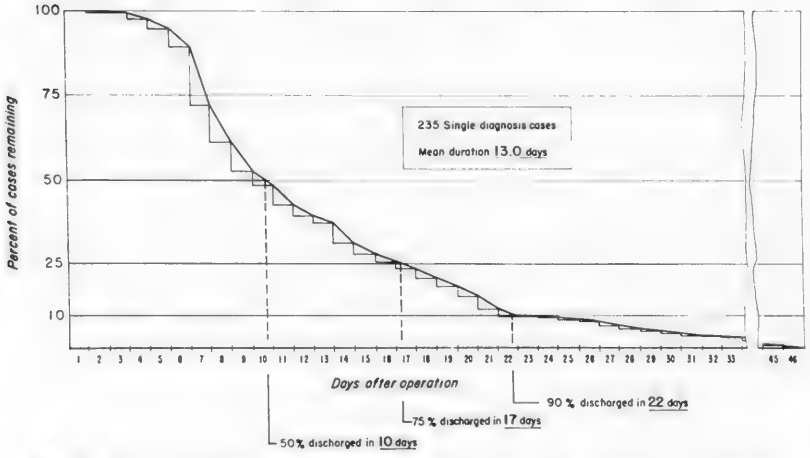

Fig. 3—Return to "full duty" from hospital following inguinal herniorrhaphy in Air Force personnel. [Reproduced by permission of Col. David Gold (MC), U.S.A.F.]

operative convalescence. The holding power of a wound, i.e. its tensile strength, is almost entirely a function of the number of fibroblasts and their maturation. Howes, Sooy, and Harvey in 1929 instituted a series of experiments to determine the velocity of healing of the experimental wound.[11] These now classical studies were first conducted on the dog and subsequently on the rat. Various types of tissues, such as skin, fascia, and stomach, were studied. The velocity of healing was the same for the various soft tissues studied for all the common laboratory animals.

As the phase of fibroplasia commences on the fifth or sixth day the tensile strength starts to increase rapidly and continues to do so until it reaches maximum strength in 12 to 14 days, the greater part being achieved in 8 to 9 days. Therefore, by the 14th day many tissues will have regained normal strength. Clinical evidence of this in animals is afforded by the studies of Allam and Martin.[3] They have shown that dogs do return to competitive racing two weeks after hysterectomy, thus suggesting that physical vigor as well as wound strength have returned to normal. Hunting dogs and horses also return to full activity far earlier postoperatively than would be expected from current clinical practice in man.

Royster, McCain, and Sloan[12] studied wound healing in relation to early ambulation in dogs. They found that the tensile strength of the postoperative abdominal wound by the 14th day was the same for both the ambulated and the control group of dogs. The individual curves of the tensile strength in their study of skin, anterior rectus fascia, and peritoneum-posterior rectus fascia were identical with those of Howes, Sooy, and Harvey.[11] This confirmed the now well-accepted clinical impression that the strength of the three important layers of the abdominal wall is neither increased nor weakened by early postoperative exercise.

These data would suggest that surgeons may allay any fears of altered wound healing with periods of surgical convalescence considerably shorter than is current civilian practice. Since maximum strength of a "clean" wound is obtained in two to three weeks in nearly all tissues, fear of disruption or of danger to the wound after the third week is usually ill founded. Clinical experience of many surgeons and that outlined below support this view.

"Shorter Periods" of Convalescence

When one compares the data of insurance statistics with those of Wenger[13] and, more recently, Gold[3] of the United States Air Force, it is evident that a marked decrease in the total convalescence period is not only possible but also safe. As a matter of fact, the average time

for return to "full duty" of Air Force personnel after common surgical procedures is about one-third the average time for civilians of similar age. Figures 1, 2, and 3 demonstrate the frequency curves of Air Force personnel covering the convalescence period following appendectomy, hemorrhoidectomy, and inguinal herniorrhaphy. The frequency curves are constructed from a 10% random sampling of the experience of 1956.

These frequency curves show that 50% of the patients after appendectomy returned to "full duty" directly from the hospital after 9 days, 50% after hemorrhoidectomy in 8 days, and 50% after inguinal herniorrhaphy in 10 days. These figures are in striking contrast to the data presented by Saffeir and Fleming in this Symposium and elsewhere.[3] In a recent study of 100 patients, we found that *not one* civilian patient returned to work by the time that 75% of Air Force personnel had returned to full duty as reported by Gold.

Johnston and Bartels,[3] working in the industrial community of Detroit, and Powers,[3] in the rural area of Cooperstown, N. Y., have demonstrated that many civilian patients do, in fact, safely undertake strenuous activity much sooner in the postoperative period than most doctors customarily permit. Johnston and Bartels studied the relationship between the stress and strain of the patients' avocations in the postoperative period as compared with that of the patients' vocations. For the 185 herniorrhaphy patients studied, they found that the determining factors relating to return to work were concerned with problems other than those having to do with the stability of repair of the inguinal herniorrhaphy. Some patients engaged in activities such as hunting and fishing, chopping wood, making repairs around the house—all while they were waiting to return to work.

Furthermore, the incidence of complications in the posthospitalization period were minimal in both number and severity in these patients. Also, it was noted that when the patients were told specifically to return to their normal occupation as soon as they felt like doing so, the average duration of the convalescence period was about one-half of that of the group in which the doctor set the date of return.

PHYSICIANS' FORECAST VERSUS ACTUAL DURATION OF SURGICAL CONVALESCENCE*

	Difference from Forecast ← Within Days →				More than Seven Days	
	0	1-4	5-7	Total 0-7	Late	Early
No. of patients	23	16	10	49	12	16
Percentage	30	21	13	64	16	20

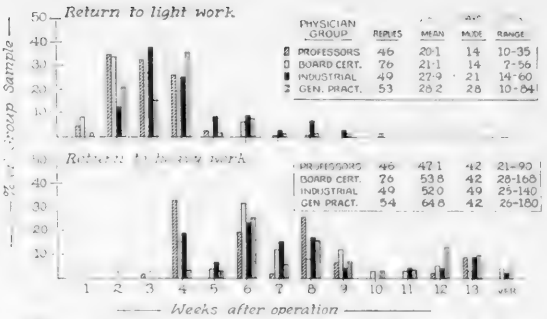
Return to light work
PHYSICIAN GROUP | REPLIES | MEAN | MODE | RANGE
PROFESSORS 46 20·1 14 10-35
BOARD CERT. 76 21·1 14 7-56
INDUSTRIAL 49 27·9 21 14-60
GEN. PRACT. 53 28·2 28 10-84
Return to heavy work
PROFESSORS 46 47·1 42 21-90
BOARD CERT. 76 53·8 42 28-168
INDUSTRIAL 49 52·0 49 25-140
GEN. PRACT. 54 64·8 42 26-180
% of Group Sample
1 2 3 4 5 6 7 8 9 10 11 12 13 OVER
Weeks after operation

Fig. 4—Distribution of recommended intervals for return to work after a hypothetical inguinal herniorrhaphy in a patient 50 years old.*

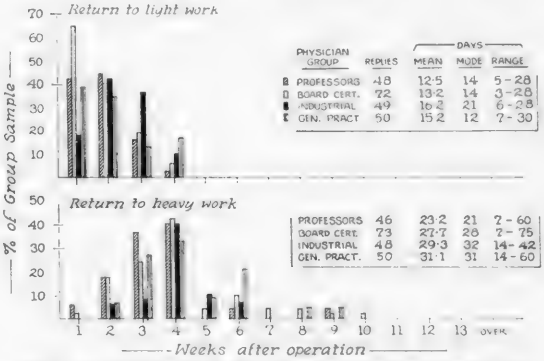
Return to light work
PHYSICIAN GROUP | REPLIES | DAYS MEAN | MODE | RANGE
PROFESSORS 48 12·5 14 5-28
BOARD CERT. 72 13·2 14 3-28
INDUSTRIAL 49 16·2 21 6-28
GEN. PRACT. 50 15·2 12 7-30
Return to heavy work
PROFESSORS 46 23·2 21 7-60
BOARD CERT. 73 27·7 28 7-75
INDUSTRIAL 48 29·3 32 14-42
GEN. PRACT. 50 31·1 31 14-60
% of Group Sample
1 2 3 4 5 6 7 8 9 10 11 12 13 OVER
Weeks after operation

Fig. 5—Distribution of recommended intervals for return to work after a hypothetical appendectomy in a patient 25 years old.*

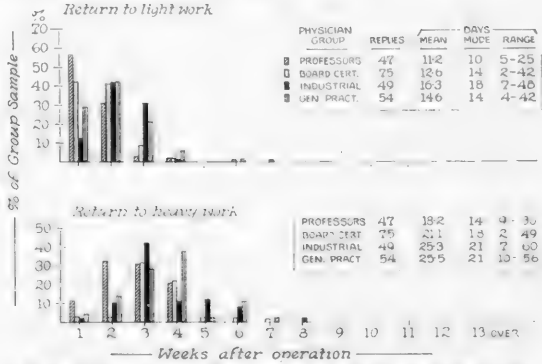
Return to light work
PHYSICIAN GROUP | REPLIES | DAYS MEAN | MODE | RANGE
PROFESSORS 47 11·2 10 5-25
BOARD CERT. 75 12·6 14 2-42
INDUSTRIAL 49 16·3 18 7-46
GEN. PRACT. 54 14·6 14 4-42
Return to heavy work
PROFESSORS 47 18·2 14 9-36
BOARD CERT. 76 21·1 18 2-49
INDUSTRIAL 49 25·3 21 7-60
GEN. PRACT. 54 25·5 21 10-56
% of Group Sample
1 2 3 4 5 6 7 8 9 10 11 12 13 OVER
Weeks after operation

Fig. 6—Distribution of recommended intervals for return to work after a hypothetical inguinal herniorrhaphy in a patient 40 years old.*

As further evidence of the important role of physician opinion in determining the total duration of surgical convalescence, the table demonstrates that 64% of patients returned to their jobs within one week of the day forecast in writing by their surgeon. This forecast by the surgeon was made in writing from 15 to 64 days (average of 34 days) before the recommended date of return to work. Therefore, the

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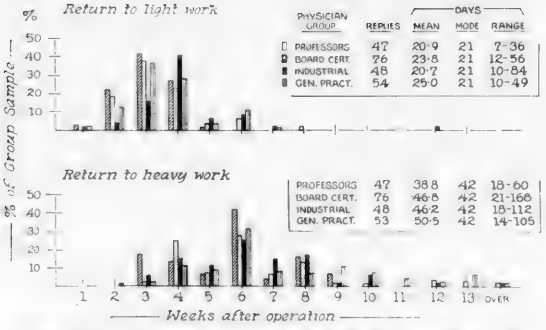
%
Return to light work
PHYSICIAN GROUP
REPLIES
DAYS
MEAN
MODE
RANGE
PROFESSORS 47 20·9 21 7-36
BOARD CERT. 76 23·8 21 12-56
INDUSTRIAL 48 20·7 21 10-84
GEN. PRACT. 54 25·0 21 10-49
Return to heavy work
PROFESSORS 47 38·8 42 18-60
BOARD CERT. 76 46·8 42 21-168
INDUSTRIAL 48 46·2 42 18-112
GEN. PRACT. 53 50·5 42 14-105
% of Group Sample
1 2 3 4 5 6 7 8 9 10 11 12 13 OVER
Weeks after operation

Fig. 7—Distribution of recommended intervals for return to work after a hypothetical cholecystectomy in a patient 42 years old.*

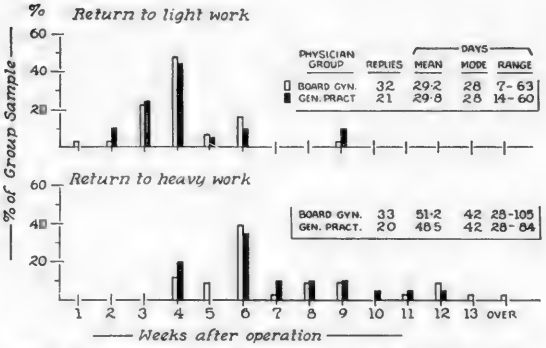

Fig. 8—Distribution of recommended intervals for return to work after a hypothetical hysterectomy in a patient 37 years old.*

prognosis by the surgeon almost five weeks previously was accurate within one week in 64% of the cases, and in 30% of the cases the patients returned on the exact day predicted by their surgeons.

Where does the responsibility really lie? It is our firm belief that the opinion of the attending doctor is the major factor in determining the total duration of the surgical convalescent period. However, opinions and practices among physicians and surgeons vary widely. For example, Moss, Schwegman, and Dohan[1] have demonstrated in a nationwide questionnaire that (in a hypothetical case) the interval recommended for return to light work after inguinal herniorrhaphy (Fig. 4) varied from 7 to 84 days and for heavy work from 21 to 180 days. A similar wide range of opinion was also expressed for the duration of the "convalescent period" after appendectomy (Fig. 5), hemorrhoidectomy (Fig. 6), cholecystectomy (Fig. 7), and hysterectomy (Fig. 8).

Should the period of surgical convalescence in civilian practice be shortened by one-quarter of that now customary, Dr. Paul Hawley, Director of the American College of Surgeons,[3] has estimated that the savings to the national economy would be more than $1,000,000,000 a year. Dr. Frank Berry, Assistant Secretary of Defense,[3] emphasized that this savings not only has economic benefits but also has important bearings on national manpower requirements.

There is now strong evidence to suggest that many persons are advised by their doctors to undergo much longer convalescence than is necessary. We believe that it is physiologically and psychologically appropriate and safe to expect much shorter periods of surgical convalescence than is current civilian practice. A greater emphasis by the attending surgeon on directed activity in the posthospitalization period will help prepare the patient for a more rapid return to his preoperative activities.[2] In a recent unpublished study we have found that such guidance is rarely given.

It is up to us as physicians to recognize the importance of shorter periods of surgical convalescence and to incorporate this principle into our future practices. As our experience with this concept enlarges, we can then better determine when convalescence really does end!!

Dr. Moss' address is 5579 N. Park Ave., Philadelphia.

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The Health of People Who Work

A Summary of the 1959 Industrial Health Forum

Norvin C. Kiefer, M.D., M.P.H., New York

THE NATIONAL HEALTH COUNCIL is a national organization, all of whose members are national organizations with sole or primary interest—or with substantial secondary interest—in health. Currently there are 66 member agencies: 48 active, 7 advisory (all Federal agencies), 7 associate and 4 sustaining members. Every major voluntary organization in the health field except the American Cancer Society; and every major professional organization in health, as well as some specialty groups, are included. An annual National Health Forum is sponsored by the National Health Council.

The Forum, as its name implies, is an instrument for exchange of ideas between representatives of the Council's member agencies and other experts. It is fully understood that, although discussions are recorded and may be published, no formal policies or decisions emerge from these forums. Nevertheless, it always is hoped that obviously useful ideas set forth in these meetings will be put into effect. The 1959 Forum had as its subject "The Health of People Who Work." The chairman was Dr. James H. Sterner, Medical Director of Eastman Kodak Company.

Naturally I was delighted over the choice of "The Health of People Who Work" as the subject of the 1959 Forum, during the period of my presidency of the National Health Council. Traditionally the Forum has been held in New York City. In 1957, however, it was held in Cincinnati, and then in Philadelphia in 1958 and Chicago in 1959. In spite of the fact that we decided that attendance at this Forum should be by invitation, the total registration was 541, over 30% more than in 1957 and 1958. Of the registrants, 58% represented national interests, substantially more than in the two previous years. They came from 32 States, the District of Columbia, Puerto Rico, and Canada. Over 60% came from outside the State of Illinois.

In this brief summary it is impossible to do more than hit a few high spots of the Forum, with resulting injustice to many, many speakers who labored with burning enthusiasm over their statements.

The general purposes of the Forum were well summarized in a telegram sent to me, as President of the National Health Council, by the President of the United States. PRESIDENT EISENHOWER said, in part:

> The concern of your present Forum, The Health of People Who Work, represents a challenge directly related to the technologic progress in preventive health matters. It involves the well-being and productivity of almost seventy million workers. . . . This is a challenge which can be met only by the combined efforts of management and labor, the health professions, government, private and voluntary health agencies, and civic and community groups. . . . My earnest hope is that by bringing together these diverse and dedicated groups your Forum will make a major contribution to the protection and improvement of the health of those on whom our national economy and security depend.

To illustrate the rapidly growing volume of the industrial health problem, Dr. Sterner pointed out that in 1900, 38% of our employed people were in farm activities but less than 10% are today. He also showed that in the chemical industry, there were 10,000 employees in 1900; 32,000 in 1914; and today there are over a million working in 12,000 plants manufacturing 9,000 different products in commercial quantities.

THE HONORABLE ARTHUR FLEMMING, Secretary of Health, Education and Welfare was the first keynote speaker. Secretary Flemming urged that five general methods be applied to consideration of a program for the health of people who work—or any other major program. Although not novel, the methods and some of the comments on them, are worth summarizing:

Dr. Kiefer is Chief Medical Director, Equitable Life Assurance Society of the United States.

From an address given at first of a series of luncheon meetings of the New York State Society of Industrial Medicine, Inc., New York University Club, New York City, June 3, 1959.

1. *We must define our objectives.* This, he said, is the most neglected process—to prove it, ask a person associated with an organization to tell you the organization's objectives. The Secretary's comment was: "Any organization that has not reduced to writing its objectives does not have a meaningful set of objectives." Incidentally, the official agency group later expressed its belief that "the United States Government should define its own objectives [in the occupational health area], both as an employer and as a public agency."

2. *We must develop programs that will enable us to reach our objectives.* The Secretary stated: "I do not know of anything that you can do that will be more constructive than to raise the sights of those who work in small organizations as they consider the objectives that should be achieved in the field of occupational health."

3. *We must identify the duties and responsibilities that need to be discharged if our programs are to be put into operation.*

4. *We must assign these duties and responsibilities to persons and organizations that are qualified to discharge them.* Mr. Flemming expressed his belief that the third and fourth methods often are neglected, particularly by local voluntary organizations.

5. *We must communicate our objectives and programs to others in such a manner as to gain the support that we must have if we are to reach our goal.* The Secretary expressed the hope that we would "stay away from professional or technical lingo." "I do not know of anything else in life that impedes progress toward well-defined objectives, towards their achievement, to a greater extent than this constant desire on our part to develop shorthand expressions which, instead of facilitating communication, impede it."*

MR. ALBERT J. HAYES, President of the International Machinists Union, was critical of some areas of industrial practice. He stated as a "tragic fact that although industry in the United States has made vast studies in the development and use of new substances, materials, and processes for production at profit, we appear to be far behind some other countries of the world in our interest and knowledge of the adverse effect of these substances and chemicals upon the men and women who are forced to use them in their quest for a livelihood." He added that "we shall have more common concern for occupational health when industry has to bear a more realistic share of the cost of occupational illness." He made another accusation that was, to me, quite startling. He said that as health benefits have been extended and improved there has developed "a sort of black market" in cases of occupational injury and disease, because under some comprehensive health plans, employees may be entitled to more extensive medical care than under workmen's compensation and occupational disability compensation laws.

MR. GEORGE BROWN, also representing labor, stated that America faces the problem of the person who works, and because America has such a problem, the people in labor think that they should be a part of the solution of that problem. Throughout the meeting, a considerable amount of emphasis was placed on the health problems of small industry.

DR. ROBERT B. O'CONNOR, Medical Director of United States Steel, expressed his preference, for occupational health purposes, for dividing "small business" into "very small"—less than 100 employees; and "small"—100 to 500. He stated that he has never seen the employment of a nurse or physician in a plant of less than 100 people work effectively. But for 150 to 200 people, part-time services of an industrial nurse are feasible and, in addition, for 200 people a physician may be effectively employed for an hour a day. Four hundred and fifty employees justifies the full-time employment of a nurse and employment of a physician for 2 hours daily. Use of the Visiting Nurse Association, he said, can work well provided that the requirement of special knowledge of industrial nursing is recognized, that no system of rotation of nurses is used and that a part-time physician also be employed. He also spoke favorably of the use of a mobile health unit for periodic health examinations. In the "very small" plant, of 25 to 50 persons, he believes that "the means of furnishing the full gamut of industrial health services hasn't yet been developed." But he believes that services for injury cases can be provided; that government agencies can be used for environmental health studies; that arrangements for periodic examinations can be made with a local physician who can become familiar with employees' health problems and working environment through visits to the plant once or twice monthly; and, finally, that advice can be obtained from the District Counselor of the Industrial Medical Association.

THOMAS MCCLELLAN, President of the Birmingham (Alabama) Paper Company pointed out that two-thirds of American working people are employed by small business. Although "big business has put in occupational health

*Later in the meeting, Dwight Thompson, a management representative, expressed the same idea and stated that he "never got beyond dermatitis, let alone hypercholesterolemia."

programs as a good investment," he said that big business turns occupational health over to a medical department and small business "does little or nothing about the matter." He stated that with respect to the use of part-time or on-call doctors "there is little to be gained other than the handling of compensation cases." He described the Birmingham Industrial Health Council, organized 10 years ago by 150 small plants. Unfortunately, two years ago it ran into serious difficulties of internal administrative problems and a conflict with the local medical society. Under the medical society ruling, activities have been limited to periodic screening examinations and health education which, McClellan believes, "is not an industrial health service but an extension of a public health program which we support by taxation."

Mr. Hayes, on the other hand, claimed that "because of the high cost and the shortcomings of individual small plant programs, we can make the greatest possible progress through the development and expansion of cooperative community programs and union health centers." He noted as the advantages: better personnel utilization; and freedom from "employer domination" and thus freedom "to approach problems of occupational health much more objectively." He also said that smaller employers, "with less access to good research and information, often exist in a state of archaic ignorance" and "the efficient safety man or medical man in the big plant sometimes lives in a sort of an ivory tower of his own building."

DR. MITCHELL ZAVON reported, for the panel on official agency functions, that occupational health programs for small industry may have to come from the official agency or with official agency guidance.

DR. ROBERT A. KEHOE expressed his belief that interest in occupational health on the part of small plant management most often is instigated by a doctor to whom a top company official happens to talk at his club, on the golf course, etc. But, he said, not enough doctors know enough about this subject to have any interest in the establishment of services in small industry; and of those who do such work at least nine-tenths think in terms of purely curative activities relating to industrial injuries and illnesses.

Dr. Kehoe provided a highly significant warning and prediction. He said that to maintain the insurance for nonoccupational illness and related programs, the costs to industry are 10 to 12 times the costs for occupational illnesses, and they are growing daily because people are learning more about what they are getting in medical care and, as they do, they want still more and will get it. He predicted that these costs therefore will continue to grow. "They will become an absolutely insufferable burden on industry and the community in general," he said, "unless we can learn more about prevention; and we have just begun to learn in this area. In occupational medicine one of our big jobs is not only to do now what we know how to do, but to learn how to do a great deal more." This, Kehoe believes, "is the future of occupational medicine."

DWIGHT THOMPSON, Executive Vice President of the Champion Paper and Fiber Company, speaking on the importance of industrial health programs, said: "The greatest and most valuable hidden asset in every enterprise is the latent, untapped reservoir of knowledge, experience, wisdom and skills of its people. Unfortunately, it never appears as conspicuously as it should on our balance and profit and loss statements." If it did, he said, we would mobilize our energies, with incredible speed, to correct inadequate attention to occupational health services. He expressed his belief that the doctor who is head of the occupational health program should be a full-fledged member of management because no member of management is better qualified to deal with problems of physical and mental health, and to evaluate company programs in terms of their impact on employees; and no members of management has greater opportunity to see employees, determine their attitudes—to find out what they think and assess their needs.

GEORGE BRAY reported from his management group the belief that "occupational health physicians' positions must be made attractive enough to bring physicians into the field" and that it is essential to "discuss and evaluate occupational health at management meetings" and to "integrate occupational health programs into every level of the organization. . . ." His group also favored "a community-organized clearing-house committee to screen health programs and health materials going into local industry."

DR. LEO WADE urged that the medical advisor's help be sought not just on matters relating to the health of employees but also to possible effects of the company's operations and products on the health of the communities in which it operates, and on the consumers who use the products. Management, he said, should expect the following from an occupational health program:

1. Provide safe and healthful working environment for all workers.
2. Select the best employees by evaluating physical and emotional factors of consequence in available jobs.
3. Furnish emergency, first-aid medical services.
4. Help employees maintain health.
5. Help management by helping employees maintain state of health compatible with high productivity and job attendance.
6. Help sick and injured employees obtain the best medical services.
7. Help management deal constructively with medical and social problems of employees.
8. Help management become or remain good corporate citizens with respect to health matters.
9. Help managers plan wisely in social insurance and welfare.
10. Help management achieve a profit by doing these things effectively but economically and, also, ethically.

Dr. Wade stated at the management breakfast that members of the National Health Council "came together with a common purpose and goal, and apparently can think collectively about a problem." "Why," he asked, "can't that be done at a local level?" He said that the National Association of Manufacturers and the National Industrial Conference Board have "played with this problem for some time . . . but have been rather impotent in getting somewhere." He added, "We have been trying to educate for 20 years. We have not reached our goal." He, and others, urged that the United States Chamber of Commerce should take more active interest in the problem.

DR. MELVILLE NEWQUIST, Chairman of the professions group, reported some possible action potentials for professional people. They included the following:

1. Provide leadership, by getting together with management, labor, voluntary health organizations, and other groups and by organization of a local occupational health counseling committee.
2. Take steps to provide an adequate number of trained occupational health people.
3. Continue and expand education of management and labor in preventive values of occupational health services.
4. Emphasize that occupational health services should be an integral part of company operation.
5. Encourage further experimentation in financial coverage.
6. Develop greater liaison and coordination between plant health services and the local medical profession.

MR. A. WEISMULLER, of the Rochester and Monroe County, New York, Health Association, in the course of extensive discussion about how best to "sell" occupational health services to management, recommended the methods used successfully by compensation carriers who sold management on the basis of savings expected under workmen's compensation laws. Mr. McClellan stated that if each person in the meeting would go back with the determination to pick out one or two leaders of small business in his community and give them the story it could be possible to "get action all over the country with those people who are actually paying the bill."

This is all I could summarize for you in this short time. I have not mentioned the vitally important discussions of paying for health services because in my opinion it should be a matter for full discussion at one or more of our future meetings. This was the principal subject of the Annual Dinner address by MR. EDWIN J. FAULKNER, President of the Woodmen Accident and Life Company, and the probable economic setting of coming programs was described at a luncheon meeting by MR. REYNOLDS NOWELL, Vice-President and Economist of the Equitable Life Assurance Society. The full text of both of these addresses will be available, and I recommend that you read them.

And now, I am going to add a brief personal comment. The full value of the discussions on "The Health of People Who Work" probably cannot be accurately appraised for at least two or three years. To some it probably seemed that Dr. Halsey Hunt was right when he described his group discussion as "the saved talking to the saved," with not many suggestions about "how to break out of this circle."

I believe that in the years ahead this 1959 [illegible] will be adjudged to have been of great value to occupational health programs. I furthermore believe that something of immediate value occurred during the meeting and its beneficial effects will continue. This was the opportunity for representatives of management, labor, health professions, government, voluntary organizations, civic groups, and industrial medicine to meet, get to know each other, and exhange ideas. Even if, in some cases, they "arrived with their minds made up and left with them crystallized," they formed—in most cases, I know—new friendships with greater respect for "the other fellow's" point of view. This alone, I contend, was worth the price.

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The Toxicity of Trichloroethylene

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TRICHLOROETHYLENE is used principally as a solvent in degreasing and dry-cleaning processes. It also has many other uses, most of which are based on its excellent solvent action for fats and oils; for example, it finds some application in the paint industry and in the extraction of fats and oils from food products. A few of its applications make use of the pharmacological effects of trichloroethylene; it has been widely used as an anesthetic and to a limited extent as a disinfectant.

Trichloroethylene, $CHCl=CCl_2$, is a volatile liquid, boiling at 87° C., solidifying at −88° C. and having a specific gravity of 1.46 at 20° C. It is completely miscible with alcohol, acetone, ether, and most organic solvents, but is soluble in water only to a very limited degree (0.04% at 25° C.). It is nonflammable and nonexplosive at ordinary room temperature but moderately flammable at much higher temperatures. (The ignition temperature is 410° C.)

Trichloroethylene has an odor resembling that of chloroform. The odor threshold has been stated by Stüber[1] to be 160 ppm, although there is reason to think that for most persons the threshold may be closer to 50 ppm.[2]

Trichloroethylene is manufactured by heating 1,1,2,2-tetrachloroethane with calcium hydroxide. A byproduct which may be formed in this reaction is dichloroacetylene. Unless the preparation is very carefully controlled, the final product may contain appreciable amounts of unchanged tetrachloroethane or dichloroacetylene, or both. Each of these possible contaminants is more toxic than trichloroethylene. In assessing the many conflicting statements in the literature on the toxicity of trichloroethylene, it should be borne in mind that not all preparations studied were equivalent in degree of purity. Exposure to oxygen or strong light will result in gradual decomposition unless a stabilizer such as triethylamine (an acid acceptor) is present. The very irritating dichloroacetyl chloride may be formed by oxidation, and further decomposition will result in the formation of phosgene, hydrogen chloride, and carbon monoxide.

General summaries of the toxicity of trichloroethylene have been published by Browning,[3] Fairhall,[4] von Oettingen,[5] and the Manufacturing Chemists Association.[2]

Toxicity—Animal Studies

In tests comparing the intravenous toxicity to dogs of trichloroethylene and chloroform, Barsoum and Saad[6] found chloroform to be the more toxic. The minimum lethal doses were 150 mg/kg for trichloroethylene and 90 mg/kg for chloroform.

In inhalation studies with small animals, Lazarew[7] found that the acute lethal concentration for the mouse was 7,400 ppm in a two-hour exposure. In a similar test Carrieu[8] found the lethal concentration for guinea pigs to be 27,000 ppm. The narcotic concentration was of the order of 3,700 to 4,600 ppm.[7, 9, 10, 11] Taylor[11] found that 0.2% produced slight drowsiness and from 0.4 to 0.5% produced deep narcosis in rats. McCord[12] found that the narcosis threshold for rabbits was 500 ppm. Taylor[11] found that trichloroethylene produced narcosis in animals with no profound effect on the respiratory or vascular system. The interval between the narcotic dose and the lethal dose was shown to be relatively wide; Genevois[13] stated that the lethal dose was about two and one-half times the narcotic dose.

Acute poisoning by trichloroethylene was shown by Barrett, Maclean, and Cunningham[14] to have little or no specific effect on the liver or kidneys of cats or rats; the usual pathological finding was acute congestion of all internal organs. With guinea pigs there were slight degenerative changes in the livers of some animals.[14] Herzberg[15] and Meyer[16] found fatty infiltration of the liver in dogs subjected to

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trichloroethylene vapors; Barsoum and Saad[6] found similar changes in the livers of dogs receiving trichloroethylene intravenously.

In experiments with rats by Adams, Spencer, Rowe, McCollister, and Irish,[17] determinations were made of the severest single exposures permitting survival of 100% of the animals. It was found that the rats survived exposure to 20,000 ppm for a period of 0.3 hour, 12,000 ppm for 0.6 hour, 9,600 ppm for 0.8 hour, 6,400 ppm for 1.4 hours, 4,800 ppm for 1.4 hours, and 3,000 ppm for 8 hours. Similar experiments with monkeys showed survival of all animals exposed to 400 ppm for seven hours, with rabbits 200 ppm for seven hours, and with guinea pigs 100 ppm for seven hours. It was reported that the only toxic effect of importance during the single acute exposures was a depressant action on the central nervous system, or anesthetic action.

In a study of chronic inhalation exposure using cats as the experimental animals, Lehmann[10] found that an exposure to 760 ppm for six hours a day over a period of 10 to 17 days produced drowsiness and loss of weight and a few deaths. Lehmann and Schmidt-Kehl[18, 19] showed that cats exposed to 3,500 ppm suffered loss of equilibrium after 75 minutes, became prostrate within 235 minutes, exhibited slight narcosis after about 275 minutes, and were in a state of deep narcosis within 300 minutes after the beginning of the exposure. When the concentration to which the cats were exposed was 22,500 ppm, loss of equilibrium was immediate, prostration occurred after four minutes, slight narcosis after seven minutes, and deep narcosis after about eight minutes. Barrett, Maclean, and Cunningham[14] found that the exposure of guinea pigs and rabbits to 1,200 ppm of trichloroethylene for 473 hours was without significant effect.

Seifter[20] exposed dogs to 500 to 750 ppm for four to eight hours daily, five to six days per week. The clinical signs evidenced by the dogs included lethargy, anorexia, nausea, vomiting, and loss of weight. There was a gradual decrease of up to 10% in the total number of erythrocytes in these dogs. The dogs showed liver dysfunction within three weeks as indicated by the sulfobromophthalein sodium (Bromsulfalein) test. The urine was found to contain free chloral. The liver showed depletion of glycogen and hydropic parenchymatous degeneration. However, microscopic study of liver sections made from dogs that were allowed to recuperate until the bromsulfalein test was normal showed no signs of liver injury.

Adams, Spencer, Rowe, McCollister, and Irish[17] exposed four different animal species seven hours daily, five days a week, to trichloroethylene vapor for about six months. The maximum concentrations of trichloroethylene found to be without adverse effect on the animals were as follows: the monkey, 400 ppm; the rat and the rabbit, 200 ppm; the guinea pig, 100 ppm.

It has been demonstrated that trichloroethylene may exert a toxic effect by absorption through the skin. In experiments by McCord[12] with rabbits, it was found that the application of 3.8 ml/kg of body weight three times daily produced some deaths after five days. A similar program with doses of 3.6 ml/kg failed to produce fatalities.

It has been stated by Mogilevskaya[21] that in addition to the narcotic effect, trichloroethylene may specifically attack the sensory fibers and the visual nerve, leading to blindness. He stated that it could cause severe hepatitis and damage to the respiratory organs, possibly due to the formation of hydrochloric acid and phosgene. The wide discrepancy between these statements and those of other workers causes one to wonder about the purity of the sample studied by Mogilevskaya.

Clinical Experience with Man

The chief concern with the use of trichloroethylene in industry is the danger of narcosis which may follow prolonged exposure to high concentrations. Most of the fatal cases recorded in the literature have involved unconsciousness as an early manifestation. Stüber[1] in 1931 recorded 284 cases of presumed exposure to trichloroethylene, 25 of which were fatal, as having occurred in German industry. Browning[3] stated that between 1938 and 1948 there were 224 cases of "gassing" from trichloroethylene reported to the Chief Inspector of Factories in Great Britain. Of these 224 cases, 10 were fatal. No comprehensive summary of American industrial experience has been published, although Quadland[22] has surveyed the medical literature from 1932 through 1943, and found 11 cases described, two of which had fatal consequences. Striker, Goldblatt, Warn, and Jackson[23] found in an investigation of 304 cases of the use of trichloroethylene as an anesthetic that there were no lasting harmful consequences.

The symptoms usually exhibited in the acute cases were signs of inebriation, giddiness, headache and loss of appetite. Stüber[1] found 10 cases of isolated trigeminal paralysis in the 284 cases studied. Disturbance of cardiac action has been reported. There were also nine cases showing optical disturbances due to lesions of the optic nerve, including two cases

of blindness from optic atrophy. Gastric disorders were fairly frequent complaints. These included nausea, vomiting, and loss of appetite. Cases have been described where abdominal cramps and diarrhea were persistent.

In a review of five fatal cases of trichloroethylene exposure, Kleinfeld and Tabershaw[24] stated that the mechanism of death in four of the five cases was most probably ventricular fibrillation. These four workmen died suddenly, either at work or shortly after leaving the plant. Autopsies showed no gross anatomical change other than congestion of the viscera, but analysis of tissues revealed the presence of appreciable amounts of trichloroethylene. There have been other reports of cardiac arrythmia following exposure to high concentrations of trichloroethylene.[25-28] These findings are in accord with the principle[29] that all fat solvents, including both hydrocarbons and chlorinated hydrocarbons, tend to sensitize the myocardium to the action of epinephrine (adrenalin), with resulting ventricular fibrillation.

It has been generally agreed that the liver is not a prime target organ. Stüber[1] went so far as to state that the liver is never affected. However, several other workers have reported that hepatitis and cirrhosis of the liver could be caused by trichloroethylene but, it appeared, much less frequently than by tetrachloroethane, carbon tetrachloride, or chloroform.

Other effects noted have been skin lesions and mucous membrane lesions. The skin effects were reddening and burning which could occur after comparatively short contact. However, serious inflammation with blistering occurred only when free evaporation was prevented by covering the skin. Instances have been reported by Stüber[1] and McCord[12] of irritation of the air passages. It was considered that this was possibly due, not to trichloroethylene itself, but to a product of its decomposition, such as hydrochloric acid.

Metabolism of Trichloroethylene in Animals and Man

Animal experiments carried out by Barrett and Johnston[30] and Barrett, Cunningham, and Johnston[31] showed trichloroacetic acid to be an end-product of trichloroethylene metabolism. Estimation of the percentage of trichloroethylene inhaled which was excreted as trichloroacetic acid in the urine of dogs showed it to be from 5% to 8%. A single experiment on a human being indicated that trichloroethylene was similarly metabolized in the human organism. Powell[22] suggested that routine blood and urine tests for trichloroacetic acid could be used as measures of harmful exposures to trichloroethylene in industry. Ahlmark and Forssman[33] showed that the extent of exposure to trichloroethylene may be evaluated by determining the trichloroacetic acid content of the urine. In an examination of 80 workers exposed to trichloroethylene vapors in the range 23-59 ppm Grandjean et al.[34] found the average ratio of urinary trichloroacetic acid expressed in milligrams per liter to atmospheric trichloroethylene expressed in parts per million to be 3 to 1. Animal experiments carried out by Fabre and Truhaut[35] indicated that both trichloroethylene and the trichloroacetic acid derived from it might be deposited in the endocrine glands, the kidneys, the brain, the blood, and particularly in the spleen and lungs.

Further studies of metabolism of trichloroethylene in the animal organism have been carried out by Forssman, Owe-Larsson, and Skog.[36] They found that, with dogs and rats, subcutaneous injection of trichloroethylene, trichloroethanol, or chloral resulted in the excretion of only a small percentage as trichloroacetic acid. On the other hand, injection of the sodium salt of trichloroacetic acid was followed by excretion of from one-third to one-half of the acid injected. Another group of animals was given a suspension of 25 mg. of tetraethylthiuram disulfide (antabuse) in olive oil by stomach tube. This material was known to be an inhibitor of oxidation of aldehydes, and thereby a potentiator of the toxicity of aldehydes and the corresponding alcohols. The animals receiving the tetraethylthiuram disulfide showed a marked decrease in the excretion of trichloroacetic acid after injection of trichloroethylene or trichloroethanol, a smaller decrease after the injection of chloral, and no change after the administration by mouth of sodium trichloroacetate. The results of this study indicated that the route of metabolism of trichloroethylene in the animal organism is that of an oxidation via trichloroethanol and chloral to trichloroacetic acid.

Toxicity of Soybean Meal After Extraction with Trichloroethylene

An unusual sideline to the toxicity of trichloroethylene developed in connection with its use as an extractant for the oil from soybean meal. The trichloroethylene-extracted soybean meal has been shown to cause a refractory hemorrhagic aplastic anemia when fed to cattle. On the other hand, soybean meal which has been extracted with hexane or benzene or even with carbon tetrachloride has never shown this type of toxicity.

The first reported poisoning of cattle with trichloroethylene-extracted soybean meal occurred in southern Scotland in 1912 and was reported by Stockman[37] in 1916. Other widespread outbreaks[38] occurred in Germany and Holland in 1923-1925 and in the United States, Italy, and Japan during the period 1947 to 1952.

Similar poisoning of horses[39] and a related poisoning of sheep[40] have been reported, but the toxicity does not appear to extend to other species.

The characteristic blood picture in trichloroethylene-extracted soybean meal has been found to be a leukopenia accompanied by a relative lymphocytosis with suggested damage to the bone marrow.[38]

Various theories have been advanced to account for this toxic action. These include, among others, the destruction of vitamins,[41] a phosphatide deficiency, and a type of urease poisoning.[38] It has been demonstrated that trichloroethylene itself does not produce this particular toxic response.

It has recently been shown by Picken and co-workers[42] that a highly toxic factor is formed by the reaction of trichloroethylene with the protein fraction of the meal. This factor has been concentrated, and its potential for causing hemorrhagic aplastic anemia has been demonstrated. A product, S-(dichlorovinyl)-L-cysteine, synthesized by these workers from trichloroethylene and cysteine, showed the typical toxicity syndrome in tests with calves, and showed physical properties in paper chromatography tests similar to those demonstrated by the toxic protein fraction from trichloroethylene-extracted soybean meal. Picken suggested that S-(dichlorovinyl)-L-cysteine may be related in structure to a part of, or may possibly be, the toxic principle in trichloroethylene-extracted soybean meal.

Maximal Acceptable Concentration

The primary consideration in the prevention of toxic effects due to trichloroethylene exposure is the control of the vapor concentration in the working atmosphere. The American Conference of Governmental Industrial Hygienists[43] and the Hygienic Guides Committee of the American Industrial Hygiene Association[44] have adopted 200 ppm as a threshold limit for eight hours' exposure daily five days a week. The adequacy of this Maximal Acceptable Concentration (MAC) has been questioned by some workers,[45, 46] and there is lack of agreement on the interpretation of the MAC value as a ceiling or as an average concentration.

Maximal Acceptable Concentrations have been set elsewhere over a wide range. For example, the firm of Imperial Chemical Industries, Ltd., in England has adopted 200 ppm;[47] the Russian figure is 9 ppm, and in Italy the value commonly used is 100 ppm.[46] Arguing on the basis of trichloroacetic acid excretion figures, Ahlmark and Friberg[48] in Sweden have stated the average daily exposure to trichloroethylene should not exceed 30 ppm.

In reviewing the European work on trichloroethylene, Stokinger[46] has raised questions concerning the purity of the trichloroethylene and the analytical methods used abroad to determine trichloroethylene concentrations. He also mentioned the lack of evidence in the United States of injury among workers exposed chronically to trichloroethylene for a period of many years.

Safety and Medical Considerations

Workers in trichloroethylene areas should be provided with eye protection of the safety goggle type. In some situations complete face protection may be desirable and can be provided by means of plastic face shields.

Inasmuch as sustained or repeated skin contact with liquid trichloroethylene may produce dermatitis, it is important that any trichloroethylene on the skin should be immediately removed by washing with soap and water. Likewise, contaminated clothing should be removed promptly and laundered or thoroughly dried before reuse. In areas where the worker is vulnerable to trichloroethylene splashes, impervious clothing, such as that made of Neoprene, may be worn.

Respiratory protection is of the highest importance in instances where it is necessary for workers to clean out tanks which have contained trichloroethylene and, likewise, in decontaminating areas following spills. Several forms of respiratory protection may be considered. The self-contained breathing apparatus involving a supply of oxygen is useful where it is necessary for the workers to move about freely. The use of an oxygen-generating chemical, such as K_2O_4, in the self-contained breathing apparatus is not recommended, since a reaction forming dichloroacetylene may occur. The airline mask is suitable for use where conditions will permit safe escape in case of failure of the compressed air supply. An industrial canister type gas mask fitted with the proper canister for absorbing trichloroethylene vapor will afford short-term protection against concentrations of trichloroethylene not exceeding 2% by volume. It must not be used when the oxygen content of the air is less than 16%

by volume, and the use must always be for a relatively short exposure period only.[2]

A person inhaling an excessive amount of trichloroethylene vapor within a short period of time will show symptoms which are associated with most volatile anesthetics. At first there may be irriation of the eyes, nose, and throat, followed by dizziness, nausea, vomiting, and gradual loss of consciousness. If one is exposed to a high concentration over a relatively long period of time, there may be a complete suppression of the pain sense and loss of muscular activity.

Chronic exposure to trichloroethylene may result in headaches, fatigue, nausea, vomiting, mental confusion, and visual disturbances. Addiction to a craving for further exposure sometimes develops.

On repeated or prolonged contact with skin, trichloroethylene exposure may result in the development of dermatitis. Frequent contact of the solvent with the skin will dry it by removal of the skin oils, making it rough and subject to cracking. This can lead to secondary infection.

On oral ingestion of trichloroethylene the initial symptoms are those of irritation of the gastrointestinal tract, such as nausea and vomiting and diarrhea. These may be followed by the development of anesthesia just as it develops after inhalation of the compound.

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Industrial Medical Aspects of Nuclear Technology

III. FUNDAMENTALS OF NUCLEAR PHYSICS, HEALTH PHYSICS AND RADIATION MEASUREMENTS—CONCLUDED

M. B. Heller, M.S., and Niel Wald, M.D., Pittsburgh

A HISTORICAL review of the broad background of nuclear physics was presented in the second article of this series. We turn now to consider those phases of physics which are more directly related to radiation health, industrial medicine, and health physics. The concepts presented in this section are the very essence of health physics practice and the foundation for understanding the biological effects of radiation. This section then, will commence with an exposition of the processes by which the various types of radiation alter the substances with which they interact. The instruments now used for detection and measurement of radiation will be discussed as will the methods by which radiation exposure is minimized.

Basic Physical Units

In order to discuss the interactions of various radiations with matter, certain terms and concepts must first be introduced briefly. The units of measurements used in radiation physics are classified in the cgs system—that is, length is measured in centimeters, mass in grams, and time in seconds. The unit of force is the dyne and is defined as that force necessary to accelerate 1 gm 1 cm per second per second. Its units may be expressed as $\frac{\text{gm cm}}{\text{sec}^2}$.

The unit for energy or work is the erg. It it the unit of energy which can exert a force of 1 dyne through a distance of 1 cm; its cgs units are dyne-cm., or $\frac{\text{gm cm}^2}{\text{sec}^2}$.

The basic electrostatic units (esu) include charge (Q), which is measured in statcoulombs (sc). The charge of an electron is 4.8×10^{-10} sc. The unit of potential is the statvolt (sv), which is equal to 1/300 of a practical volt (V). The unit of energy is the erg (E). $V \times Q = E$.

A convenient unit of energy or work used by the nuclear physicist is the electron volt, which belongs to no particular system. It is the amount of work done when one electron is accelerated by a potential difference of one practical volt.

$V \times Q = W$

$$\frac{1 \text{ volt}}{300 \text{ sv/volt}} \times 4.8 \times 10^{-10}\text{sc} = W_{(\text{ergs})} = 1 \text{ ev}$$

$$1.6 \times 10^{-12} \text{ erg} = 1 \text{ ev}$$

Natural extensions of the electron volt are the kiloelectron volt (kev), the million electron volt (mev) and the billion electron volt (bev).

Half-Life

All radioactive isotopes transform themselves, or decay, at a rate which is characteristic for each isotope; that is, a certain fraction of the number of atoms present will disintegrate in any given unit of time. This fraction, called the decay constant, is represented by the symbol λ and is expressed mathematically by the following expression:

$$\lambda = \frac{\frac{\Delta N}{N}}{\Delta t} \qquad (1)$$

where: N = number of atoms decaying in time, t
N = number of atoms present
t = unit of time (which must be very small in relation to the half life)

It is convenient to refer to the amount of time it takes for one-half of the atom in a given radioactive substance to decay. This is called the half-life ($t_{\frac{1}{2}}$). The specificity of $t_{\frac{1}{2}}$ for an isotope makes it a valuable tool in the identification of unknown radioactive elements. The half-life is related to the decay by the following expression:

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$$t_{1/2} = \frac{0.693}{\lambda} \qquad (2)$$

Rather than use the actual number of disintegrations occurring in a period of time (which may yield large numbers), it is common to use a unit called the curie. This is defined as 3.7×10^{10} disintegrations per second. Also used are the millicurie (mc), 3.7×10^{7} d/s, and the microcurie (μc), 3.7×10^{4} d/s.

As a practical example of the half-life concepts, if we now have 20 millicuries of I^{131} which has a $t_{1/2}$ of 8 days, then at the end of one-half life we will have 10 mc, at the end of 16 days we will have 5 mc, in 24 days there will be 2.5 mc, etc. At the end of seven half-lives we will have less than 1.0% of the original activity.

If the decay constant is known, the quantity of activity or number of radioactive atoms present at any given time may be expressed by:

$$N_t = N_0 e^{-\lambda t} \qquad (3)$$

where: t = time
N_t = amount remaining at time, t
N_o = amount originally present
e = base of natural logarithm, 2.718
λ = decay constant

Interaction with Matter—Alpha Particles

Alpha particles have a specific range in any given material depending on their energy. The most energetic (approximately 10 mev) alphas have a range of about 3 inches in air and will be completely stopped by a few sheets of paper or thin aluminum foil. At the end of its range the alpha particle will be non-ionizing, since it will have picked up two electrons to convert it to a helium atom. The monoenergetic nature of alpha particles leads to an absorption curve of the type indicated in Figure 1. Interaction is accomplished by electronic excitation and ionization—that is, by accelerating electrons out of the atoms near its path, forming ion pairs (the electron and positive ion). Approximately 35 electron volts are absorbed in the production of an ion pair. In air, about 30,000 ion pairs are formed per centimeter. Naturally, the denser the material, the more interactions per unit path length and hence the greater the relative stopping power of the material.

Interaction with Matter—Beta Rays

Beta particles are emitted in maximum energies ranging from about 0.017 to 5 mev. The loss of energy of beta particles in matter is due almost exclusively to two processes: (1) collisions which produce ionization and excitation, and (2) radiation produced by deflection. The first is a multiude of inelastic collisions and is similar to the process whereby alpha particles lose their energy. Owing to its smaller charge and mass, however, the beta particle has a lower specific ionization (75 i.p./cm. air) a longer range, and a tortuous path. The second process is identical with that by which x-rays are produced. The beta particle is decelerated by the nucleus and its path is altered much like the path of a meteor around the sun. The deceleration produces electromagnetic radiation. This radiation is called "Bremsstrahlung," or "braking radiation."

It will be observed in Figure 1 that beta radiation of a given maximum energy has a specific range in a given material. The slope of the curve is due partly to the spectral distribution of beta energies, partly to the loss of energy by conversion to radiation, but also largely to the marked scattering and frequent changes of direction of the beta particles. This fortuitous combination of factors yield an absorption curve which approximates a straight line over a large portion of the range in a semilogarithmic plot. The unit of absorber thickness generally utilized in referring to beta ranges is "density-thickness." This is the product of the

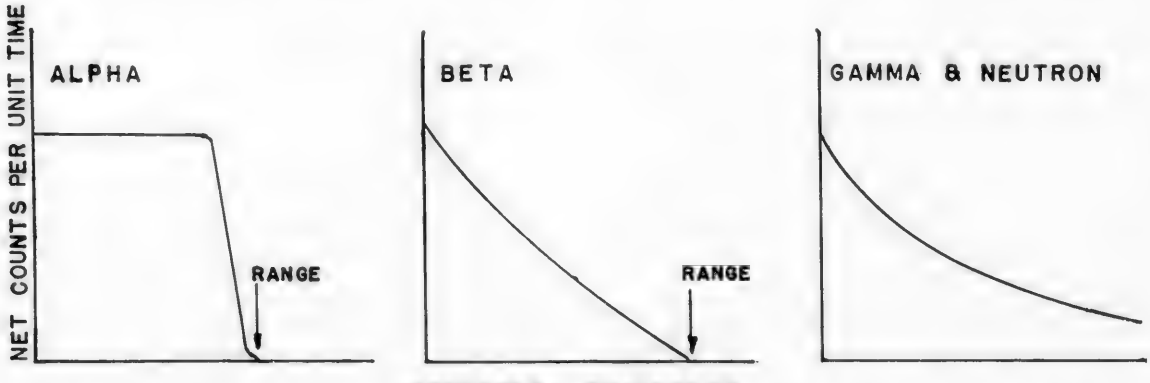

Fig. 1—Absorption curves for α, β, γ rays and neutrons. The first two have a definite range; the latter two are absorbed exponentially.

thickness of the absorber in centimeters multiplied by the density of the substances in mg/cm³ or gm/cm³. For example, a 2 mm thick sheet of aluminum has a density thickness of 0.2 cm × 2.7 gm/cm³ = 0.54 gm/cm² or 540 mg/cm².

Interaction with Matter—Gamma Rays

We have seen that the various types of ionizing radiation may each occur in a rather wide range of energies. The energy of a given photon or particle will determine (1) the manner in which it will interact with matter and (2) the density of ionization along the path the radiation takes. The latter is a factor which has a great bearing on the absorbed dose of radiation.

Gamma rays and x-rays are very penetrating, but the degree of penetration, or effective range, depends on the energy. X and gamma rays may occur in energies ranging from about 0.01 to 30 mev. As they pass through matter, gamma rays lose their energy, and hence are absorbed. Low energy photons interact chiefly with tightly bound electrons, higher energy photons with more loosely bound electrons, and very high energy photons interact with the field of the nucleus. The absorption of gamma radiation is also a function of the density and the thickness of material involved and is characteristic for each material or substance. The linear absorption coefficient (μ) gives the relative loss of intensity per unit length of path. It is related to the half-value layer ($X_{\frac{1}{2}}$) in the same way as the decay constant is related to half-life:

$$\mu = \frac{0.693}{X_{\frac{1}{2}}} .$$

The three major methods of photon energy absorption are: photoelectric effect, Compton scatter, and pair production. Each of these results in the complete elimination of a photon from a collimated beam and the beam is consequently attenuated exponentially in passing through matter; that is:

$$I = I_0 e^{-\mu x} \qquad (5)$$

where: I = new intensity
I_0 = initial intensity
x = thickness of absorber

Figure 1 illustrates the exponential absorption of photons.

Low energy photons can interact by direct collision effect with an orbital electron. The orbital electron which becomes a photoelectron, will then be ejected from the shell in the atom with an energy equal to that of the incident photon minus the binding energy. The photoelectric process has the highest probability of occurring when the energy of the photon is only slightly above the binding energy.

Approximately 80% of photoelectric interaction involves the K-shell electrons. The loss

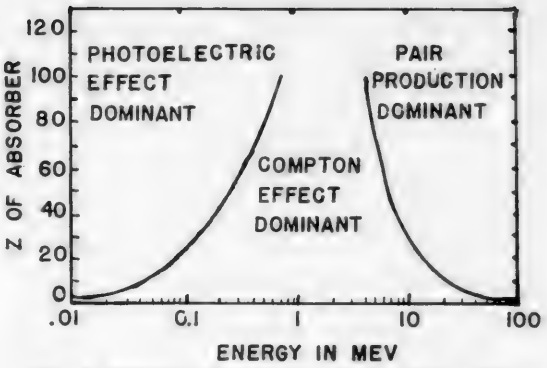

Fig. 2—Relative importance of the three major types of gamma interaction. The lines show the values of Z and mev for which the two neighboring effects are just equal.

of an electron in an inner shell results in a void which is filled by an electron from one of the outer shells. As the electron moves to fill the void the emission of characteristic electromagnetic radiation occurs. Figure 2 shows the energies and absorber atomic numbers in which the photoelectric effect is dominant. As the photon energy, hf, increased beyond the K-shell binding energy, E_k, of a given element, photoelectric absorption becomes of decreasing importance and Compton scatter of greater importance. For energies greater than 0.20 mev the binding energy of the electron will be of little import, since E_k for even the heaviest element is only about 0.11 mev.

In Compton scatter, the incident photon is deflected by the electron which it ejects from the atom. The total energy is conserved, since the energy lost by the photon, which is now of longer wave length, is represented entirely in the energy used to dislodge the electron and impart the kinetic energy associated with its velocity. As the energy of the photon is increased, pair production becomes more important, particularly for high z absorbers (Fig. 2). Pair production has a threshold at 1.02 mev, since the energy equivalent to the mass of an electron (m_0c^2) = 0.511 mev and two of these masses (the positron and electron) must be formed when the photon interacts with the nuclear field. Thus, when a 10 mev photon interacts in a pair process, the total kinetic energy of the electron and positron is 8.88 mev, and this energy can be shared in any number of ways. The positron is annihilated by an electron, and the energy $2m_0c^2$ appears in the form of two annihilation quanta ejected in opposite directions, each with an energy of m_0c^2.

Interaction with Matter—Neutrons

While the interaction of charged particles with matter is due almost entirely to electro-

static forces and the emission of radiation, the interaction of neutrons with matter is entirely dependent on the direct collision between a neutron and a nucleus. Consequently, neutrons travel long distances, compared with charged particles, before they are absorbed in matter. Their energies may range from 0.025 ev to 10 mev.

The passage of neutrons through matter resembles that of photons in that each collision of a neutron with a nucleus results in the removal of a neutron from the incident beam. There is, therefore, an exponential attenuation of the beam.

The collisions of neutrons with nuclei can be divided into three classes:

1. Elastic scattering, in which a neutron is deflected without loss of energy except for the kinetic energy which it imparts to the recoiling nucleus.
2. Inelastic scattering, in which there is an interaction between the nucleus and the neutron resulting in the emission of a neutron with an energy different from that of the incident one.
3. Capture, in which a neutron is absorbed into a nucleus which then undergoes some reaction (other than the reemission of a neutron). These reactions include the emission of a photon, or, in the cases of U^{233}, U^{235}, and Pu^{239}, nuclear fission.

Heavy charged particles such as protons lose their energy by the previously described method of ionization which may be accelerated to energies exceeding 3,000,000,000 electric volts. The range is generally short, and scatter of the particle occurs to a lesser degree than in beta particles.

Radiation Dosimetry

The intensity of electromagnetic radiation at any point is defined in its precise sense as the radiation energy in ergs passing per second through 1 cm^2 of area perpendicular to the direction of propagation. If, in addition, the enrgy spectrum of the radiation is given, then the radiation at a given point is completely specified. The relationship of incident energy flux to the rate of energy absorption in any physical or biological system depends primarily on the photon energy. Because the detection and measurement of any radiation necessarily involves energy absorption by the measuring system, intensity measurements and dose or dose-rate measurements will be seen to present similar problems. The ease or difficulty with which they are solved depends in a like manner on radiation quality. At this point we are primarily interested in the energy absorbed by the medium and the various units which may be used in expressing this energy absorption. Since any consideration of the primary physical action of ionizing radiation must be based on energy absorption, the fundamental unit of physical dose is the energy absorbed in ergs per gram of irradiated material.

The roentgen (r) was given its present definition at the Chicago Congress of Radiology (1937). The definition reads: "The roentgen shall be the quantity of x- or gamma-radiation such that the associated corpuscular emission per 0.001293 gm. of air produces, in air, ions carrying 1 esu of quantity of electricity of either sign." This unit has serious limitations. It is hardly to be expected that the roentgen could apply without qualification to the whole range of quantum and corpuscular radiation now available. The validity of the roentgen becomes questionable when the secondary corpuscular emission is not in equilibrium with the primary quantum radiation. For example, the roentgen is inadequate as a statement of the dose at an air-tissue interface, such as the skin, where a finite depth must be reached before secondary electronic equilibrium is attained. The difference between the true energy absorption in the surface tissue and that implied by the roentgen dose is unimportant for x-rays generated at potentials up to a few hundred kilovolts but becomes one of considerable magnitude in the case of high-energy radiations. In order to avoid such difficulties and to bring corpuscular radiation dose under one and the same definition, a number of units have been proposed, all expressed essentially in terms of energy absorption without necessarily specifying the type of radiation involved. If 1 gm of air, rather than 1 cm^3, is exposed to a dose of 1 r, the amount of energy absorbed is approximately 84 ergs. This unit is termed the gram-roentgen. It is not equivalent to the energy absorbed by 1 gram of tissue owing to the difference in mass absorption coefficients of air and tissue.

In order to refer to dose absorbed in tissue from any type of ionizing radiation, the roentgen-equivalent-physical (rep) unit was suggested. It is defined as "that dose of ionizing radiation which produces an energy absorption of 84 ergs per cm^2 in tissue." The value was originally chosen to be the same as the energy absorption per roentgen per gram of air and was not identical, therefore, with energy absorption per roentgen in tissues, since this depends on both tissue composition and radiation quality. Later the value of the rep was changed to 93 ergs/cm^3 of tissue, because this figure represents more accurately the energy absorption per cm^3 of aqueous tissue which has received a dose of 1 r of hard x- or gamma rays. This correspondence between the rep and the

roentgen holds only for aqueous tissues and for quantum energies at which neither photoelectric absorption nor pair production is important.

It has been noted that equal energy absorptions of different radiations may not produce equal biological effects. To correct for these differences, the relative biological effectiveness (RBE) of various types and energies of radiation have been determined experimentally using a variety of biological end-points such as death, spleen-thymus weight loss, and cataract production.

Attempts have been made to correlate the RBE with some physical property of the radiation. If a particular physiological effect is considered in a given organism or tissue, there appears to be a general relationship between the RBE of the radiation and its specific ionization (the number of ion pairs formed per centimeter of path). It has, however, been found preferable to use a related quantity called the linear energy transfer, or LET, defined as the energy released by the radiation per unit length of absorbing tissue. In general, when comparing different ionizing radiations, it is found that the RBE increases with LET, although for very high values of the latter the RBE may decrease somewhat.

Multiplying the dose to mammalian tissue in rad by the RBE, for the particular radiation involved, yields a result in the unit "rem" (roentgen equivalent man). This unit is intended to express the dose delivered to man by any ionizing radiation which is biologically equivalent to 1 r of x- or gamma radiation. Unfortunately, however, the RBE varies not only with type and energy of the radiation but also with each biological end-point studied. It is therefore not necessarily valid to apply RBE values of neutrons and other types of radiation, which were determined for one specific system or organ, to the case of another organ or whole-body exposure. For example, the RBE for fast neutrons for cataract formation is 10. If the hand or the whole body is exposed to fast neutrons, what basis is there for adopting the same RBE of 10? Until more is known about how each kind of radiation affects all tissue target areas, there is some doubt about the accuracy of the assumptions implicit in the use of RBE and rem units. These are biological dose units, suitable under certain special conditions, but not for all situations.

Instead, the unit of absorbed dose now widely employed is the rad. It is arbitrarily and clearly defined as the absorption of 100 ergs per gram from any type of ionizing radiation by any material. There is no attempt at making it "equivalent" to the roentgen as in the case of the rep. Experience drawn from experimental research as well as from reactor and criticality accidents has shown the rad to be a most useful and acceptable unit in expressing dose.

Radiation Detection and Measurement

The term detection may be used to include not only the determination of the presence of nuclear radiation but also the measurement of its amount, energy, and related properties. A detection system can be considered to have two parts, a detector and a measuring apparatus. The interaction with radiation occurs in the former, and the latter takes the output of the detector and performs the functions required to accomplish the measurements.

Different types of detectors may be characterized by the nature of the interaction with the detector. Several types operate by virtue of the ionization which is produced in them by the passage of charged particles. These include ionization chambers, proportional counters, Geiger-Müller counters, and crystal counters. In detecting uncharged particles such as neutrons and gamma rays, the charged particles which are required for the production of ionization originate by the secondary processes which have previously been described. In certain detectors, excitation and sometimes molecular dissociation also play important roles. These phenomena, in combination with ionization, produce the luminescence generated in scintillation detectors and the latent images in photographic emulsions.

The ionization chamber, proportional counter, and Geiger-Müller tube are all modifications of the same principle of detection. Essentially, they consist of a gas-filled cylinder with a well insulated positively charged central electrode. Assume that the passage of a nuclear particle releases N_1 ion pairs within the chamber. The positive and negative charges within the chamber move toward the chamber wall and central electrode respectively, because of the direction of the electric field. The charge collected at the central electrode as a function of voltage is represented by Curve 1 in Figure 3. For a particle producing a larger number of ion pairs, such as an alpha particle, Curve 2 is obtained.

These curves can be divided into four main regions. In Region I there is a competition between the loss of ion pairs by recombination and the removal of charge by collection on the electrodes. With increasing field the drift velocity of these ions increases; therefore the time available for recombination decreases, and the fraction of the charge which is collected becomes larger. In Region II (ionization chamber region), the recombination loss is negligible

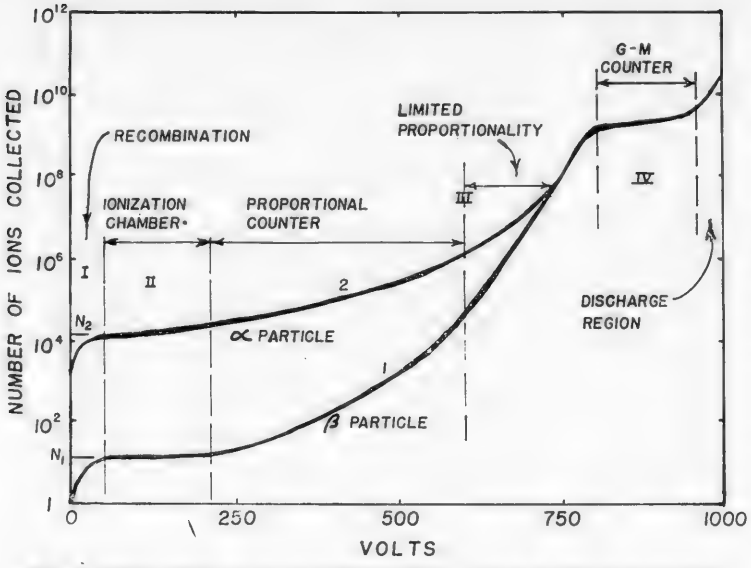

Fig. 3—Pulse-height versus applied-voltage curves to illustrate regions of operation.

and the charge from all ions is collected. This region is also known as the saturation region.

In Region III the collected charge is increased by a factor through the phenomenon of gas multiplication. The electrons which are released in the primary ionization are accelerated sufficiently to produce additional ionization and thus add to the collected charge. At the onset if Region III, the multiplication for a given applied voltage is independent of the initial ionization, thus preserving the proportionality of pulse sizes. This strict proportionality breaks down with increase in applied voltage until, at the upper limit of Region III, the pulse size is independent of the initial ionization. This region, in which gas multiplication is employed while at the same time a dependence of the collected charge on the initial ionization remains, is known commonly as the proportional region. The upper end of it is designated as the region of limited proportionality.

In Region IV, the charge collected is independent of the ionization initiating it. Rather, gas multiplication increases the charge to a value that is limited by the characteristics of the chamber and the external circuit. This region is known as the Geiger-Müller or G-M region.

In health physics applications, the high amplification and hence high sensitivity of the G-M counter makes it a desirable instrument for scanning and detection of radiation sources. It is limited to measuring dose rates of 50 mrad per hour and lower because of its sensitivity. Instruments of this type are often called survey meters, or G-M probes. The ionization chamber is less sensitive, indicates true dose rate more accurately, and has no upper limit of dose rate. Typical of this device are the cutie-pie and juno meters.

When ionizing particles pass through certain crystals, flashes of light, or scintillations, are emitted. In the modern scintillation detector, this light is picked up by a photomultiplier tube, and the resulting pulse of current out of the photomultiplier indicates the passage of the ionizing particles through the scintillator. Under proper conditions, the resulting charge is proportional to the energy lost by the ionizing particle in the crystals. Thus, as in the cases of the proportional counter and the pulse ionization chamber, this detector can be used to measure the energy distribution of particles in addition to counting them. The scintillation detector can be used for all types of particles. At the present time it is the most versatile type of nuclear-radiation detector. Its sensitivity and proportional characteristics make it the ideal detector for utilization in low-level radioactivity counting, including human whole-body radiation counters.

Photographic emulsions are used extensively in radiation protection, in the form of film badges. Their primary use is to assess the integrated dose received in a given period. The film is worn in a badge which partially covers the emulsion with various materials. The resulting differences in film optical density can be related to various types and energies of radiation by comparison with a series of film calibration curves. Films can be used to measure doses from 10 to 30,000 mrad. Special films are made for the detection of neutrons. Exposures are measured by the microscopic counting of proton recoil tracks which are formed in an (n,p) reaction in the emulsion.

Health Physics Practice

The goal of health physics is the prevention and reduction of radiation exposure and hazard. This applies not only to those personnel using radioactivity in their work but also to those populations in the vicinity of installations using and producing radiation. In referring to the potential hazards which are inherent in radiation work it is customary and convenient to subdivide them into the categories, (1) external and (2) internal, based on the location of the radiation in relation to the body. One must bear in mind, however, that no matter what the

source of ionization, the ultimate effect is on the cellular level.

External Hazards

External hazards include radiation of x-ray machines and particle accelerators, encapsulated isotopes used as external radiation sources (Co^{60} sources, beta applicators, etc.), and all radiations which can penetrate the walls of their containers. These usually include the penetrating radiations such as gamma rays and neutrons as well as the most energetic beta particles. There are three methods of reducing external hazards in common practice today: shielding, distance, and time. Knowing the energy, the energy of the radiation, and the material to be interposed, adequate shielding may be designed for an installation by utilizing equation (5). For gamma radiation, lead is usually the shielding material of choice because of its high absorption coefficient. For beta shielding, however, lead would be a poor choice, since the production of Bremsstrahlung increases rapidly with increase in atomic number. Aluminum and Lucite are most effective as beta shields, and, since there is a finite range involved, thicknesses can be designed to stop radiation completely. Neutron shields must be composed of low atomic number elements for efficient absorption. In practice, water, paraffin, and the like are used.

The second means of limiting external exposure is distance. Like any other electromagnetic radiation, the intensity of gamma and x-rays is reduced inversely as the square of the distance. That is, if the dose rate at 1 foot from a source is 100 mrad per hour, the dose at 5 feet will be 1/25, or 4 mrad per hour. This is implemented operationally by the use of long-handled tongs and other remote handling equipment.

The utilization of time limitation as a method of reducing external exposures is usually reserved for situations in which the first two control methods are impractical or impossible. If a certain task must be performed in a high radiation area, then the dose-rate is assessed by use of radiation survey meters and the length of time one individual may work is computed. If the dose rate in a given area is 400 mrad, then, using the current maximum permissible average exposure of 100 mrad per week, the most time a worker may spend in that area is 15 minutes.

Internal Hazards

The general effects of nuclear radiations from ingested radioactive materials are essentially the same as those already discussed above, but there are certain circumstances in which even a very small quantity of such sources within the body can produce considerable injury. Any radionuclide entering the body is a potential hazard, but most serious consequences can result if the element is one which tends to concentrate in cells or tissues that are highly radiosensitive. For example, calcium and the chemically similar strontium, barium, and radium are called "bone seekers," since these elements are largely deposited in the skeleton. Plutonium and cerium are also bone seekers, although they are found in other parts of the bone. Radioisotopes of these elements can thus be very hazardous, since they will collect, to a considerable extent, in the bone if ingested. Here the radiations, even if of short range, can injure the sensitive bone marrow, where many blood cells are produced. Also, the continuous bombardment of bone tissue by radiations may eventually lead to necrosis and tumor formation.

The most important factors in determining an internal exposure dose are the mass of radioactive material deposited, its half-life, the nature and energy of the radiations emitted, and the length of time it is effective in the body. This time is dependent upon two factors; one is the ordinary radioactive half-life, and the other is the "biological half-life." The latter is defined as the time taken for the amount of a particular element in the body to decrease to half its initial concentration due to elimination by natural (biological) processes. Combination of the radioactive and biological half-life gives rise to the "effective half-life," which is the time required for the amount of a specified radioisotope in the body to fall to half of its original value as a result of both radioactive decay and natural elimination.

The control of internal hazards is based on the prevention of contact between the radioisotope and the normal routes of entry into the body. This is implemented by the use of hoods, gloves, respirators, and protective clothing. Experience has shown, however, that the best methods of control are education of personnel to the nature of the hazard and good housekeeping.

Maximum permissible concentrations of radionuclides in air and drinking water are based on the level which can be maintained continuously in the body or critical organ without exceeding a dose rate of 300 mrad per week and are set forth in N.B.S. Handbook 69, entitled "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure," and in the Federal Register Part 20, Chapter 10.

Frequent monitoring of environmental levels of radioactivity is used as an index of effective controls of contamination levels. External dose is monitored by ionization chambers and G-M counters. The use of film badges and pocket ionization chambers has become standard for almost all radiation users. These provide an integrated measure of the dose personnel have received. It should be emphasized that the methods used to measure radiation dose are only physical or chemical systems which are intended to simulate the energy actually absorbed by a biological system. These instruments, then, are useful only to the extent to which they do approximate the absorbed dose which would be received by an individual in that place.

A vital aspect of health physics practice is the maintenance of survey and exposure data in an orderly system of record keeping. The medicolegal aspect of such records is quite obvious. In addition, there is a great deal yet to be learned regarding radiation effects on human populations, particularly in the low dose range. Such records will have inestimable value in future epidemiologic studies.

Summary and Preview

In the previous article and this one, which comprise the coverage of nuclear and health physics in this topical review series, an attempt has been made to provide a basis for understanding the nature of radioactivity and the physical means by which it produces biological effects. The next topic will be a detailed consideration of the biological effects of radiation ranging from those occurring at the molecular level to those involving the whole human organism.

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Industrial Medical Association

THE PRESIDENT'S MESSAGE

D. JOHN LAUER, M.D.

IN ANY large group of people it behooves someone to understand the dynamics of neurotic behavior.

In industry, that someone might well be you! The industrial physician often is looked to for such understanding, especially if he demonstrates some aptness in this direction.

Who among us is not confronted with the aging auditor who with increasing frequency attempts to solve his personal problems by taking refuge in alcohol; or the faithful clerk who, after a prolonged hospitalization for a mental breakup, seeks his old job back, only to find a wall of resistance from supervisor and fellow employee alike; or the ambitious but immature young chemist whose hypochondriasis ebbs and flows with his successes and failures; or the truck driver who has a convulsive seizure after 15 years of accident-free road service, and for whom no definitive diagnosis can be made after careful study; or the underground miner whose back injury improves to just short of the point where he might return to his regular work.

Who among us can approach a formal grievance conference in an objective and understanding manner when we are confronted by the bitter barbs of a complaint filed by a paranoid craftsman-patient and pressed by his ambitious union steward.

We may hate to face these problems. To retreat neither solves nor abolishes them.

One can hardly be surprised at the strong interest in mental hygiene demonstrated by our members at the annual meetings of the IMA. Last spring a capacity crowd filled the large ballroom to participate in the seminar arranged by the Committee on Mental Health.

In the year ahead, Chairman Del Caldwell expects his Committee on Mental Health to stimulate regional workshops and seminars, to develop reference files of journals, texts, reprints of speeches, etc., and to provide the JOURNAL editorial board with suitable reviews and abstracts.

In a more ambitious, long-range plan this committee expects to explore the development of a nosology for psychological components in health records of employees, much as one grades heart cases. Such a classification might effect a standard reporting center by industry units of all types of employee mental health experiences for review and analysis.

* * *

Last year the Committee on Small Plant Services did two outstanding pieces of work. In addition to producing an exhibit depicting occupational health services in small industries, businesses, and offices for display at medical meetings, Chairman Logan Robertson and his committee prepared a pithy and informative brochure directed to managements. The folder emphasizes the dictum, "Employee health services pay their way!" If you haven't yet, read it! use it!

* * *

NOTE: Have you thought of giving a JOURNAL subscription to a colleague, or to your hospital library?

Editorials

Convalescence After Surgery

The group of articles constituting the symposium Convalescence After Surgery is timely and illuminating. It is timely because the cost to industry for personal illness and hospitalization is 8 to 10 times the cost for occupational illness and injury. The facts presented are illuminating because they offer a measuring stick of what the length of disability should be following surgical procedure. More important, this presentation should stimulate surgeons and family physicians to reevaluate present concepts regarding optimum periods of disability after operations. These concepts are not based on scientific data or observation but, rather, reflect a compromise between what the patient and his relatives might accept and the thinking of the operating physician. One is reminded of the acceptance of early ambulation for the surgical patient—how successfully it has proved to be beneficial to the patient, and how at the time of its introduction many of us felt "why hasn't this been done before."

The results of laboratory studies on healthy animals cannot wholly be applied to humans. There are many important factors involved in the healing process of wounds, such as alteration of the body physiology by the underlying disease process, the nutrition of the patient, the type of operation itself, and the complications which may occur. These are variables that cannot be incorporated into an animal experiment, yet they are important determinants of the time required for recovery from surgery. The loss of muscle tone occurring in the athlete or the workman following prolonged absence from usual activity must also be considered. One reaches a point of diminishing return by too long absence from work because the tone of muscle and fascial tissues is allowed to deteriorate.

In attempting to change preconceived ideas as to the length of disability following any operation we must remember that we are dealing with people and that the mental attitude, not only of the patient but of his immediate family, must also be considered. As has been stated many times, there are two main factors which affect a man's return to work following illness, injury, or operation: One is the extent of the injury, illness, or operation itself, and the other is how the individual reacts to it.

If, through research and study, new concepts regarding this problem are developed, there still is a "selling job" that must be done to the practicing physician and to the public.

The Lowest Level

We appear to be making progress toward the management of the health problems of a segment of our working population that so far have been more than a match for any system of privately financed medical care, as well as an unmet challenge to our official agencies. These relate to the one and one-quarter million migrant agricultural workers who move about the country to harvest the crops and who make up the lowest layer of the work force.

The U.S. Public Health Service has just released a report entitled, "Public Health Service Activities Related to Agricultural Migrants, 1955-59," that reveals the difficulty of applying the official agency programs to this problem. Some 900 agricultural counties periodically receive migrant workers who now are known to have the astounding prevalence rate for syphilis of 10 to 14%, and who with their dependents usually harbor cases of active tuberculosis and infectious diarrhea. These are matters that ordinarily would come under the direction of state and county health authorities. The difficulty here is that the services of local agencies are by law usually restricted to the citizens of the political jurisdiction concerned, and federal groups have no power to act. This dilemma, together with a long list of additional problems, social and esthetic, are now the subjects of study of an impressive array of committees and experts at the state and national levels. We may hope that good solutions to these problems will appear in the near future.

Book Reviews

CURRENT CONCEPTS OF POSITIVE MENTAL HEALTH. By Marie Jahoda, Ph.D. Price, $2.75. Pp. 136, with introductory "Staff Review" by Jack R. Ewalt, M.D. and concluding "Viewpoint of a Clinician" by Walter E. Barton, M.D. New York, Basic Books, Inc., Publisher, 1958.

This is the first of a series of monographs being released by the Joint Commission on Mental Illness and Health preliminary to the final official report to be made in accordance with the Mental Health Study Act of 1955.

Dr. Jahoda, a social psychologist, has made an extensive and intensive coverage of the literature on criteria for mental health. She presents many ideas, for comparison and consideration, with careful scientific reasoning. She summarizes most comprehensively and makes many ingenious suggestions for empirical research on the characteristics of positive mental health.

Dr. Ewalt's introduction provides a built-in book review which highlights the prominent features of the report and explains the difference in emphasis between Dr. Jahoda's psychological approach and the "rebuttal" by Dr. Barton. Dr. Barton introduces many examples of biological factors influencing mental health. He argues for absence of mental illness as a practical criterion for mental health, in contrast with Dr. Jahoda's viewpoint that "absence of disease may constitute a necessary, but not a sufficient, criterion for mental health."

The occupational physician, with his traditional medical approach toward health, through prevention of illness, might find himself impatient with the abstract discussions of various values in individual human psychology: of attitudes toward the self, self-actualization, integration, reality orientation, autonomy, perception of reality, and environmental mastery. The bulk of the material in the report will have its greatest appeal to specialists in the behavioral sciences, concerned with research and with the theoretical conceptualization which is necessary for future progress. One derivative of the scholarly discussion, with practical import for the occupational physician's responsibilities in the maintenance of mental health, is the support which is given for the value in American culture that an adult "individual should be able to stand on his own two feet without making undue demands or impositions on others" (Ewalt).

This reviewer would like to contribute one semantic point toward resolving the debate between Dr. Jahoda and Dr. Barton. Since health is a medical term which has been equated by physicians with absence of illness, why not use a psychological term for criteria which are not on the continuum between mental illness and absence of mental illness? Dr. Jahoda is writing about something different from absence of mental disease, statistical normality, or states of well-being. Perhaps this something is "maturity," or perhaps Dr. Jahoda can find a better term. "Physical fitness," a term for something more than absence of biological disease, although it begs the question "fitness for what," suggests a positive concept going beyond physical health. Dr. Jahoda has mapped out areas for research on the something which relates to mental health as physical fitness relates to physical health. Such basic research will ultimately have relevance to occupational medicine, just a basic research in physiology does, even if the occupational physician might find little of immediate practical application in this first of the reports of our national commission on one of the major areas of health.

—W. DONALD ROSS, M.D.

THE APPRAISAL INTERVIEW. By Norman R. F. Maier. Price, $5.95. Pp. 246. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, 1958.

In his latest work N. R. F. Maier makes a striking case for the so-called problem-solving interview. In effect, he says, the appraisal interview should not be an annual discussion with an employee of his strengths and weaknesses of job performance, but rather should stimulate growth and development in the employee by listening to him, reflecting his own ideas and feelings, and, possibly, helping him solve problems which he himself may raise during nondirective discussion. The appraisal process itself, he feels, should be a year-long, continuing one, unrelated to such periodic discussions.

A compelling case is made for the problem-solving interview as he contrasts it with two other forms: The "tell and sell" and "tell and listen" interviews. While not stated in this volume, the conclusion that Dr. Maier apportions all appraisal interviews into three categories represents a neat but oversimplified basis for favorable comparison of his highly touted problem-solving approach.

Following an explanatory but concise introductory chapter, the bulk of the book is devoted to transcripts of six interviews, role-played by competent and sensitive social scientists. This transcription is aptly interspersed with comments on the interview content and the reactions of each participant. There follows a chapter on problems associated with the three interview styles discussed. Two final chapters contain many useful concepts to illustrate the application of the problem-solving approach to executive development and to the improvement of superior-subordinate relationships.

If the reader can accept the thesis that the appraisal interview should not be a place for criticism of an employee, if he can forget what he has read about structuring the performance appraisal, there will be much of interest for him here. If this work, however, contained more detail concerning the problem-solving interview itself, it would have greater general value. To this reviewer, there is a disturbing theme here. There appears an underlying presumption of an ease of developing sensitivity and skill required to follow adequately the format recommended. Learning such techniques is difficult for the professional; all but impossible for the action-oriented manager.

Physicians, usually well trained in sensing material which is emotionally meaningful to their patients, are more accustomed than most members of management to the needs of an interviewee. In the conduct of a medical history, for instance, many of the "problem-solving" techniques espoused here are used by the skilled clinician. This reviewer is not convinced that Dr. Maier's volume will contribute a great deal to the techniques of the medical interview. It is not designed to. It *does* offer stimulating ideas to those physicians with supervisory responsibility. Despite its provocative format and many stimulating suggestions, this work remains largely a report of an interesting experiment demonstrating the necessity of skill and sensitivity in the conduct of an effective problem-solving interview. —ALAN A. MCLEAN, M.D.

RADIATION BIOLOGY AND MEDICINE: SELECTED REVIEWS IN THE LIFE SCIENCES. By various authors and contributors, Walter D. Claus, editor. Price, $11.00. Reading, Mass., Addison-Wesley Publishing Company, Inc., 1958.

A physician in occupational medicine usually has relatively little contact with the therapeutic or research uses of radiation. His interest is the basic concepts of radiation biology and medicine is undoubtedly limited. Let more and more he is being confronted with new radiation hazards within his plant. If he is lucky, he has an assistant carefully trained in health physics who can clarify the physical aspects of a radiation problem. He, nevertheless, frequently finds himself in need of a good reference book on radiation biology.

"Radiation Biology and Medicine" satisfies this need with a series of reviews of selected topics on the effects and uses of radiation in the life sciences. Although it was not written primarily for the practicing physician, he may be surprised at how interesting and useful this book can be. For example, the industrial physician may have been disturbed by the implications of recent congressional hearings on radiation injury. Mr. Claus' discussion on the "Concept and Philosophy of Permissible Dose to Radiation" which is in Part 6, "Radiation Safety," provides a good orientation to this subject.

If one were to plot on a graph total biological damage against lifetime dose rate, he would have difficulty with the portion of the curve where the dose rate and damage are small. The slope of this portion of the "damage curve" is still not known. Does it lie flat for a considerable distance, indicating that the population can repair small damages as fast as they are produced by low radiation exposure rates? Is it possible, as some evidence suggests, that the curve takes a dip before steadily rising, indicating that small doses have a beneficial effect? Or, as most experts believe, is it a straight line extrapolation from zero? Since no one knows these answers yet, the lifetime dose level from zero to 0.1-0.3 r/week has to be described as an "area of uncertainty."

In view of this uncertainty, the obvious next question is "How much can this country afford to pay for protection against unknown damage?" Somewhere between no protection and no cost and complete protection and intolerable cost must lie an area of reasonable compromise. This necessarily involves a "philosophy of risk." As Mr. Claus points out, we must balance known benefits to our health and well-being with a certain amount of unknown risk from the somatic, genetic, and bioeconomic effects of low level radiation exposure. The entry of the politician, lobbyist and overenthusiastic health crusader into the field of radiation injury has made the determination and interpretation of maximum permissible dose levels difficult. Nevertheless, the general recommendations of the International and National Committees on Radiation Protection are now *the* basic guides. These groups have attempted to keep these guides reasonably flexible, but, unfortunately, as they are translated into legislative codes they tend to lose their original flexibility. The present recommended limits are presented and explained clearly by Mr. Claus.

Sometimes the physician in industry may quickly need information on the physical and physiological properties of some of the important fission products or other radioactive heavy elements. The effective energy, critical organs [critical organ is the body organ which accumulates the greatest concentration of the radioisotope or by virtue of its increased radio sensitivity or essentiality to life is most vulnerable to the radio-nuclide] and the physical, biological, and effective half-life in days for over 25 elements are listed in an excellent table in Chapter 14. The per cent uptake in the blood from the G.I. tract, uptake in critical organs from blood, and the per cent of the total body burden in the critical organ are also included. Finally, the per cents which reach the critical organ by inhalation and by ingestion, when known, are listed. [Many may wish to make a copy of this complete table to put near their telephone.] In this chapter the general problem of the internal emitters is discussed, and the radiobiological effects of radium, uranium, plutonium, thorium, strontium, and several other elements are briefly reviewed.

An idea of the comprehensiveness of this volume can be gained by a quick look at the table of contents. The book is divided into two major sections, Radiation Effects and Radiation Uses. The first includes the basic mechanisms of Biological Reactions to Radiation, Mutational Effects, Mathematical Biology, the Mammalian Response to Radiation and Radiation Safety. The section on Radiation Uses includes Medical and Agricultural Uses, Tracer Applications, Instrumentation and Dosimetry.

If one confines himself only to the chapters which have clearcut medical implications, he will miss much fascinating material. The discussion of the uses of radiation to eliminate destructive insects is typical. This is included in the chapter on the Entomological Uses of Radio-isotopes.

The extensive bibliographies which appear after each chapter are especially valuable for those who wish to explore any of the subjects further. AEC opportunities for training in radiation biology and related sciences are discussed in Appendix A.

—T. A. LINCOLN, M.D.

Abstracts of Current Literature

Mental Health

Graham C. Taylor, M.D.

Facing up to the Stress and Strain of Modern Life. W. C. Menninger.* Menninger Quart. 13:12 (Spring) 1959. (*Menninger Foundation, Topeka, Kan.)

Given sufficient stress anyone can reach a "breaking point." There may be internal tensions arising from personal conflicts perhaps related to childhood experiences, and there are external tensions more closely tied up with the social environment, including the job situation. The person filled with anxiety cannot look at himself objectively, and so he needs help in understanding his problems. The author makes three recommendations. First, there should be an evaluation and discussion of the causes of the person's tension. Second, the person should try to "assume full responsibility as a person, as a member of a family, as a participating citizen." Finally, there should be a thoughtful consideration for the future; this includes the vocational as well as educational and recreational planning.

Newer Phenothiazine Drugs in Treatment of Nervous Disorders. J. Kinross-Wright.* J.A.M.A. 170: 1283 (July 11) 1959. (*Baylor University College of Medicine, Houston, Texas.)

The author states: "It has been estimated that one-third of the practice of medicine is devoted to the treatment of nervous disorders, and it is a fact that one-half of the nation's hospital beds are devoted to this purpose. While chemotherapy is by no means the only treatment available to these patients, it is perhaps the one of greatest concern to the average physician."

This article deals with two recent tranquilizing drugs, i.e. trifluoperazine (Stelazine) and thioridazine (Mellaril)—derivatives of phenothiazine. The former drug, being more potent, is considered best for hospitalized patients but can be used for office patients in lower doses. The second drug, with about one-tenth the potency of the first drug, is recommended for office use as well as hospital use. Stelazine has side-effects of an extrapyramidal nature, and these are described in some detail in the article. They can be controlled by anti-Parkinsonian agents such as benztropine (Cogentin).

Current Theoretical Concepts in Psychosomatic Medicine. Harold I. Kaplan and Helen S. Kaplan.* Am. J. Psychiat. 15:1091 (June) 1959. (*Department of Psychiatry, New York Medical College, New York, N. Y.)

The term "psychosomatic" is used very frequently in modern medicine. Unfortunately, considerable confusion attends its use, for, as the authors of this article point out, "There is, in fact, currently no one theory, construct, or set of variables adequate to explain the observed and assumed relationship between psychological difficulty and physical malady. Indeed, even the definition and limitation of what constitutes a 'psychosomatic disease' is controversial." They undertake to examine critically various theories, and they indicate that there are two major approaches. First is the specificity theory, which rests on the belief that the individual's personality and the psychological trauma determine the type of illness. It should be noted that the older concept of patients with certain types of personalities having specific diseases is no longer held.

The second broad group, the nonspecific approach, holds that various psychological stresses may be associated with disordered physiology leading at times to organic disease—this depending more on the physical than on the psychological processes.

The authors assert that there is insufficient information available for them to decide which theoretical set of concepts is best and that one should maintain an openminded and flexible attitude toward the entire problem.

Management and the Problem Drinker. F. I. Colonna.* Management Rev. 48:22 (Sept.) 1959. (*Bellevue Medical Center, New York, N. Y.)

This article is based on experience at the Consultation Clinic for Alcoholism of the Bellevue Medical Center of New York University. There are discussions of who is an alcoholic; the high cost of alcoholism; the alcoholic personality; the vicious circle (alcohol to combat feelings of low self-esteem resulting later in still lower self-esteem); denial and the problem drinker; the early signs; what industry is doing. In 1947 the Consolidated Edison Company established a Company procedure on Alcoholism, regarding it as a medical problem. In 1952 this same Company financially supported the Consultation Clinic for Alcoholism at Bellevue, and since then Standard Oil of New Jersey and about 18 additional companies have availed themselves of the Clinic's facilities. The problem drinker at the Clinic is studied by the internist and interviewed by the staff psychiatrist. Psychological tests are available. A treatment plan is evolved which includes psychotherapy, individual or group.

The Nature and Use of Committees. E. I. Green.* Advanced Management 24:24 (July) 1959. (*Bell Telephone Laboratories, New York, N. Y.)

Committees apparently are becoming popular and increasingly used; hence the occupational physician is inevitably involved in committees of one type or another. This article by the Executive Vice-President of The Bell Telephone Laboratories examines critically the values of committees. He refers to conclusions arrived at by the Laboratory of Social Studies at Harvard to the effect that the

Abstracts

optimum number of committee members is five. Also that 50% of the meeting time should be devoted to information, questions and 50% devoted to answers and reactions. "There should be precisely two positive reactions to each negative one. A ratio lower than this indicates a divisive and emotional situation, while a higher one indicates inhibition, restraint and domination by the chairman."

There is a section on the advantages of committees, which includes excellence of decisions, strength of decisions, and the development of personnel.

The section on shortcomings of committees refers to inferiority of decisions, impotency of decisions and depreciation of the line organization. The author has included a chart on the uses of committees in which he evaluates their value for different functions. For example, committees are rated as poor with respect to implementing decisions but excellent for advising management. They are rated as being of value in particular situations only for operational decisions. The author concludes by recommending that there might be recourse to a committee on committees.

Internal Medicine

S. H. Stradley, Jr., M.D.

Gross Digital Clubbing and Exopthalmic Ophthalmoplegia in Thyroid Disorders. A. G. Freeman.* Lancet 2:57 (July 12) 1958. (*Bristol Royal Infirmary and Bristol Eye Hospital, Bristol, England)

The author has analyzed six cases in all of which there were clubbing of the fingers and exophthalmus. Five patients had undergone either partial thyroidectomy or x-irradiation for thyrotoxicosis. In four patients, digital clubbing appeared between six weeks and nine months after one of the above methods of treatment. The clubbing closely followed the symptoms of hypothyroidism. Pretibial myxedema was present in three of six cases. Of considerable interest is the report of a case of untreated active thyrotoxicosis with gross digital clubbing and exophthalmic ophthalmoplegia. It appears that digital clubbing closely followed the onset of clinical signs and symptoms of toxic goiter in this instance.

The recent concept of an "exophthalmus-producing" hormone of possible pituitary origin, and distinct from the "thyroid-stimulating" hormone is discussed, as is the question of digital clubbing and its relation to pituitary dysfunction.

It is concluded that since gross digital clubbing in association with exophthalmic opthalmoplegia is now reported in a patient with hyperthyroidism, as well as in induced euthyroid and hypothyroid states, support is lent to the theory that pituitary dysfunction may be responsible for these clinical manifestations.

Clinical Significance of Serum-Transaminase Levels. Lancet 2:1317 (Dec. 20) 1958.

The enzymes serum-glutamic-oxaloacetic-transaminase (S.G.O.T.) and serum-glutamic-pyruvic-transaminase (S.G.P.T.) are widely distributed in human tissues. The serum level of S.G.O.T. rises 6 to 12 hours after a myocardial infarction. It reaches a peak 24 to 48 hours after the infarction and returns to normal by the fourth to the seventh day. The S.G.O.T. is of value if there is extension or if a second infarction occurs. A secondary peak will then occur, while the electrocardiogram has not changed. Diagnosis is often difficult. If there is an arrhythmia with coronary infarction, a rise in S.G.O.T. may prove helpful. The S.G.O.T. level relates to myocardial necrosis. Anginal pain at rest with an electrocardiogram which is abnormal but not diagnostic but with an elevated S.G.O.T. has the same prognosis as electrocardiographically proved infarction. Subendocardial infarction may have a normal S.G.O.T. level. S.G.O.T. may be elevated in pulmonary embolism with shock or with rupture of the left pectoralis major muscle.

In hepatic disorders both enzymes may be increased, as in carbon tetrachloride poisoning and viral hepatitis. Some observers believe that the S.G.P.T. increase in the latter disease exceeds that of the S.G.O.T. Relapse in hepatitis is associated with a secondary increase. Failure of the enzymes to reach a normal level suggests chronic hepatitis.

The enzymes are useful in differentiating the jaundice of hepatocellular disease from extrahepatic obstructive jaundice. Higher levels obtain in hepatocellular disease. Hepatic and biliary cirrhosis are mentioned as is neoplastic disease of the liver.

A Further Study of the Kveim Reaction in Sarcoidosis and Tuberculosis. H. L. Israel,* M. Sones, H. Beerman, and T. Pastras. New England J. Med. 259:365 (Aug. 21) 1958. (*Graduate School of Medicine, University of Pennsylvania, Philadelphia)

Enthusiastic reports of the specificity of the Kveim reaction in sarcoidosis continue to appear. The authors have attempted to duplicate the results of other investigators, such as James and Thomson, who found the test positive in 12 of 16 patients with clinical evidence of sarcoidosis, and Nelson and Schwimmer, who obtained positive results in 74% of 53 patients with the disease.

In the investigation reported, the test was completed on 46 patients with sarcoidosis; only 28.3% were positive. In patients with tuberculosis, 29 tests were completed; there were no positive reactions in these patients.

The authors conclude from their experience that a positive Kviem reaction in a patient suspected of having sarcoidosis may be indicative of (1) sarcoidosis, (2) a false positive due to loss of "specificity" of the test material, (3) a false positive due to overreading by the pathologist.

A negative test may indicate (1) absence of sarcoidosis, (2) a false negative, due to the testing material having lost its' potency, (3) a false negative in a patient whose sarcoidosis is in, or about

to enter in, remission, (4) a false negative due to underreading by the pathologist.

From the results of their recent investigations, the authors are of the opinion that the Kveim reaction in its present for is not a sufficiently reliable or reproducible test to justify its use as a substitute for clinical and biopsy methods in the diagnosis of sarcoidosis.

Noise and Hearing

Horace O. Parrack

Relation Between Recovery from Temporary Threshold Shift and Duration of Exposure. W. D. Ward,* A. Glorig, and D. L. Sklar. J. Acoust. Soc. America 31:600 (May) 1959. (*Research Center, Subcommittee on Noise, 111 North Bonnie Brae Street, Los Angeles 26.)

Earlier experiments performed by the authors indicated that recovery from the temporary hearing threshold shift (TTS) produced by exposure to noise was proportional to the logarithm of the recovery time. The amount of TTS present two minutes after cessation of exposure (TTS_2) was taken as the point from which recovery was measured. Additional studies on recovery from the TTS produced by exposure to the 1200-2400 cps octave band of noise are reported. Exposures to this band of noise were 12 minutes at 106 db band sound pressure level (SPL); 27 minutes at 98 db SPL; and 117 minutes at 90 db SPL. The TTS_2 at 4000 cps measured for the respective exposure times and SPLs were 18.3 db, 19.6 db, and 20.8 db. The recovery from TTS was followed for 152 minutes, at which time the remaining TTS was as follows: for the 106 db and 12 min. exposure—TTS = 6 db; for 98 db and 27 min. exposure—TTS = 4 db; and for 90 db and 117 min. exposure—TTS = about 3 db. These results lead to the conclusion that for a given frequency the recovery from TTS is independent of exposure duration or level of the TTS-producing noise except insofar as these parameters determine TTS_2 (TTS at 2 min. recovery).

Making Compressor Stations Quiet Enough to Live With. W. J. Severin.* Oil & Gas J. 57:96 (May 4) 1959.

This paper points out that the last 10 years have seen a significant increase in noise problems within the industry concerned with the transmission of natural gas. The noise problems are primarily associated with the equipment used in compressor stations. In one station, the author states that the over-all noise levels anywhere in the compressor building ranged between 111 and 113 db. In the same station, the noise level in the air intake and exhaust manifold was 125 db. In another station, of different design, the noise levels are reported as 90 db or above in the main engine room, 99 db at ground level, and 118 db at the top of the air receivers of the installation. A variety of the actions taken to reduce the noise in the first station are described by the author. These reduce the over-all noise level in the engine room to 106 db, a reduction of 7 db. The design changes and noise reduction treatments employed in the second type of station reduced the noise level readings in the entire engine room to 92 db and reduced the noise at the top of the air receivers from 118 db to 92 db. The methods employed to obtain the noise reductions described are discussed in sufficient detail to be of considerable value to the occupational medicine staff that may be faced with similar noise problems.

Acoustical Factors in Jet Airport Design. K. M. Eldred.* J. Acoust. Soc. America 31:547 (May) 1959. (*Western Electro-Acoustic Laboratory, Inc., 11789 San Vicente Blvd., Los Angeles.)

The author reminds us that the acoustical environment of an airport has always created difficult problems for the designer because the sound energy (noise) from the aircraft operations adversely affects passengers, employees, and neighbors. Data, primarily from military sources, have stimulated a general awareness of the significance of noise from jet transport operations for problems of personnel protection, airport planning, community relations, providing adequate voice communication, and maintaining the physical and mental comfort of passengers. The sound fields of current propeller transport aircraft are compared with those measured or computed from the first series of jet transports, and it is shown that protecting the hearing of personnel working about the airport and maintaining a necessary minimum efficiency of voice communication will become much more critical problems when jet transports are operated in large numbers. Sufficient data are given for this series of early jet transports to allow one to design airports where personnel are protected and where necessary communication is possible if the data and the criteria relevant to the effects of noise on man are used by designers. Specific data that define the hazards to the ear are given, together with discussions on the means for providing ear protection for those exposed to the airport noise. Representatives of airline and airport medical services will find specific data, applicable to their problems, in the 17 figures and 2 tables which are used to present information on this complex problem.

Action of the Middle Ear Muscles in Normal Cats. R. Galambos* and A. Rupert. J. Acoust. Soc. America 31:349 (March) 1959. (*Department of Neurophysiology, Walter Reed Army Institute of Research, Washington, D.C.)

It is quite generally understood that the middle ear muscle (tensor tympani and stapedius) act to protect the human ear from intense sounds. Direct investigation of this process in man is difficult. The authors have developed methods for permanently placing electrodes in cats to record the electrical responses of the inner ear while unanesthetized animals are exposed to sounds. The data obtained indicate that the effective sound

level may be reduced 20 to 22 db by action of the middle ear muscles and that the stapedius muscle is largely if not entirely responsible for this effect. Although these experiments do not prove that man's tympani muscles behave in the same way, there are observations that indicate a similar process for man, and these data do suggest the order of magnitude of the protection afforded. It should be noted that the muscles require time to contract and no protection can be expected when very short intense sounds strike the ear, if they last for only 1/100 to 1/50 second.

Medical Care Administration

Asa Barnes, M.D.

Medical Care Under the Health Insurance Plan of Greater New York. E. F. Daily.* J.A.M.A. 170:272 (May 16) 1959. (*Vice President, Health Insurance Plan, Greater New York.)

The Health Insurance Plan of Greater New York (HIP) provides home, office, and in-hospital care to 550,000 persons utilizing 32 group operated medical centers. It provides medical care, not cash indemnities, and is obligated to establish professional standards and to assure a high quality of medical care. All groups must meet the professional standards established by the HIP medical control board. The 32 medical groups have over 1,000 physicians; approximately one-half are family physicians and the other half specialists. Each subscriber has his choice among the groups serving his community and within the group makes a choice of family physician.

All participating physicians have their training and experience reviewed and approved by a medical control board consisting of 18 leading physicians. Each group has monthly staff meetings to review case reports, morbidity, and mortality. There is an educational fund to defray half the cost of tuition for postgraduate courses taken by physicians.

Payment is made on a capitation basis; $31.80 per year for each person enrolled in the group. For this they agree to cover all medical care covered by the contract and needed by the enrollee. Physicians are not permitted to make extra charges irrespective of the family's income or type of service provided except for a $2.00 charge for home calls after 10 p.m. and before 7 a.m. Studies are constantly being made of the quality of medical care. HIP is profiting by its experiences and is steadily moving closer to the provision of comprehensive medical care of a high quality through full-time medical groups with modern medical facilities.

Occupational Health—The Great Hiatus. H. K. Abrams.* Papers and Proceedings, National Conference on Labor Health Service, Washington, D.C. June 16-17, 1958, p. 113. (*Medical Director, Union Health Service, Inc., Chicago.)

Occupational health is a basic part of public health, yet very little is being done on the public health level in this field. The prevalence and incidence of occupational disease in the United States are unknown because in many states there is no reporting of occupational disease and in those where they are reported there is no uniformity. Many occupational diseases are not recognized because of medical ignorance, deficiencies in medical education, and deficiencies in workmen's compensation laws.

At least nine states have no occupational health units, and all state agencies together have only 27 physicians employed. Research in occupational health is largely in private industry and is guided by economic need of industry. Governmental agencies have made contributions, but their resources are inadequate. Some specific needs are (1) stronger federal and state industrial hygiene agencies, (2) development of public tax-supported research facilities and programs, and (3) training of professional personnel.

Labor's job consists of legislative support on the federal, state and local level to strengthen occupational health programs and to improve workmen's compensation. More attention must be given by labor to occupational health and medical care.

The Bituminous Coal Country: A Psychiatric Frontier. J. K. Morrow,* J. P. King, D. D. Chiles, and T. E. Painter. West Virginia M. J. 55:164 (May) 1959. (*Saint Albans Psychiatric Hospital, Radford, Va.)

This is a report on how a small psychiatric hospital through cooperation with a labor welfare organization has been able to lead in organizing psychiatric services in formerly barren areas involving portions of four states. The story begins with the organization of the UMWA Welfare and Retirement Fund and the area administrators' groping about for the best psychiatric care they could find. Saint Albans Psychiatric Hospital of Radford, Va., became involved when they began to accept some referred patients. Geographically, the area served is the bituminous coal-mining areas of western Virginia, West Virginia, eastern Kentucky and eastern Tennessee.

An office was opened at Bluefield, W. Va., with the psychiatrist traveling on regular schedule to other population centers of the area. These facilities were later expanded, and a psychiatric team consisting of a psychiatrist, clinical psychologist, and psychiatric social worker was established. A similar clinic was set up at Knoxville, Tenn., and later at Beckley, W. Va. The greatest surprise was the overwhelming way in which the clinics were enthusiastically welcomed into the communities. Although a major portion of time is alloted to Welfare Fund patients, the clinics have been able to do much work for other agencies.

Group psychotherapy has proved a valuable adjunct in many of the patients, first in the hospital, then in the clinics. Many patients do extremely well with only a minimum stay in the hospital. The clinic arrangement has been able to do much preventive work with cases that might otherwise drift

along to hospitalization. Not only have the clinics brought a good many patients to the hospital, but the patients are far more likely to be cases who can actually be helped.

Reparative Surgery

Robert J. Trettin, M.D.

Wound Debridement. H. H. Ziperman.* Postgrad. Med. 26:34 (July) 1959. (*Brooke Army Medical Center, Fort Sam Houston, Texas.)

Although the principles of debridement as outlined by the author were learned by dealing with combat wounds, they are equally applicable to missile wounds resulting from civilian disaster or gunshot, or high velocity perforating industrial injuries.

The following principles of adequate debridement apply to all missile wounds: (1) adequate skin incision to permit adequate excision of all nonviable tissue; (2) incisions in the direction of the long axis of the extremity except over flexion creases; (3) minimal excision of skin; (4) incision of fascia to the full extent of the skin incision to permit adequate exploration of more extensively damaged underlying muscle; (5) adequate excision of nonviable muscle, based on color change, loss of contractility, change in consistency, and absence of bleeding; (6) flushing of wounds with saline solution; (7) hemostasis; (8) keeping wounds open for delayed primary closure (closure is accomplished in 4-10 days after debridement, provided there is no clinical evidence of infection) and (9) laying of fine mesh gauze base dressing on wounds, not packing it into wounds depths.

Wounds of the Liver. G. F. Madding.* S. Clin. North America 38:1619 (Dec.) 1958. (*Stanford University Medical School, San Francisco.)

The author describes the essential points in diagnosis and management of the patient with a liver injury and emphasizes several features.

Of the injuries involving abdominal organs, those of the liver may be the most difficult to treat because of the multiple problems involved in their proper care. The seriousness of an injury to the liver is dependent upon three factors: (1) error in diagnosis, (2) presence of associated lesions, and (3) improper therapy. Multiple visceral involvement is the most important single factor in prognosis, which is closely correlated with the degree and duration of shock.

The definitive treatment of all liver wounds is surgical. Operative treatment is imperative because of the high mortality attendant on the nonoperative treatment. Three factors must be considered during an exploratory operation in such a patient, namely (1) bleeding, (2) destruction of hepatic tissue with drainage of bile into the peritoneal and or pleural cavities, and (3) associated intra-abdominal or intrathoracic injuries.

The establishment of adequate external drainage of bile and products of tissue injury, which includes, when the occasion warrants, the placing of drains within the liver substance proper, is the most important feature in the surgical care of all liver wounds. The use of the gauze pack should be avoided except as a temporary measure during the operative procedure.

Clinical Use of Intravenous Fat in Surgical Patients. W. H. Marshall.* A.M.A. Arch. Surg. 78: 851 (June) 1959. (*University of Illinois College of Medicine, Chicago.)

It has been repeatedly demonstrated that intravenous fat emulsions provide the need for a high-calorie, low-volume intravenous nutritional supplement in pre- and postoperative care. Early attempts to utilize fat emulsions were accompanied by too high an incidence and severity of side-reactions to permit their clinical use.

The author reports a study of 95 surgical patients receiving 580 units of Lipomul I.V. demonstrating the relative freedom of this improved emulsion from side-effects. The only significant toxic reaction is a bleeding diathesis, which has been seen only in patients receiving 15 or more units of fat. It is characterized by fever, lethargy, epistaxis, petechiae, gastrointestinal bleeding, hepatosplenomegaly, progressive anemia, prolongation of clotting time, and a decrease in prothrombin time. The bleeding complications are not as yet fully understood but occur only after two weeks or more of daily infusions.

The author concludes that Lipomul I.V. represents an important advance in the pre- and postoperative care of nutritionally debilitated surgical patients and is safe for routine clinical use. The number of infusions should be limited to 14 per patient.

Clinical Toxicology

Lee H. Miller, M.D.

Diisocyanates: Toxicology; Résumé. J. A. Zapp, Jr.* A.M.A. Arch. Indust. Health 19:350 (March) 1959. (*Haskell Laboratory, Wilmington, Del.)

"Polymeric materials, prepared by the reaction of polyisocyanates with other materials, such as polyols, are being widely used as adhesives, plastics, rigid or elastic foams, and synthetic rubber. These polymers present no unusual toxic hazards. The diisocyanate monomers commonly used in their preparation, however, are very irritating materials, even though their systemic toxicity is not great.

"Inhalation of the vapors of the isocyanate monomers leads to irritation of the respiratory tract, which may be followed within hours by asthmatic attacks. Opinion is mixed as to whether these asthmatic attacks are allergic in origin or not, but the evidence suggests that some persons develop a hypersensitivity to the isocyanates after repeated exposures.

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"Skin tests with guinea pigs have shown that the most widely used isocyanate monomer, toluene-2,4-diisocyanate, is a weak skin sensitizer, and it is assumed that the same would be true of other polyisocyanates. Sensitization dermatitis is rare, however, among those preparing polymers based on the isocyanates. This may be partly owing to the fact that the irritating nature of the material naturally leads to cautious handling.

"I have suggested that the maximum concentration of toluene-2,4-diisocyanate in the air should not exceed 0.1 ppm, basing this estimate on the response of animals to concentrations of 1 to 2 ppm. The experimental work supporting these findings and recommendations with respect to the toxicology of the isocyanates can be found in an article by me, 'Hazards of Isocyanates in Polyurethane Foam Plastic Production,' which appeared in the *A.M.A. Archives of Industrial Health* (15:324-330, 1957)."

Nickel Poisoning: VIII. Dithiocarb: A New Therapeutic Agent for Persons Exposed to Nickel Carbonyl. F. W. Sunderman* and F. W. Sunderman, Jr. Am. J. M. Sc. 236:26 (July) 1958. (*Division of Metabolic Research, Jefferson Medical College, Philadelphia)

Nickel carbonyl is a highly volatile and extremely toxic gas. The MAC is 0.001 ppm of air for an exposure of eight hours. Potential hazardous exposures may occur during the separation of nickel from its ores, the preparation of intermediates in organic syntheses (sometimes under extremely high pressures), electroplating operations, and inadvertent formation whenever carbon monoxide comes into contact with an active form of nickel. Nickel carbonyl lacks a strong odor, and severe symptoms may develop insidiously hours or days after exposure. The symptoms are of two types, initial and delayed. The initial symptoms, which are usually mild and disappear on cessation of exposure, may include headache, giddiness, nausea, coughing, dyspnea, and weakness. Delayed reactions are characterized by severe retrosternal pain, complaints of tightness in the chest, cough, dyspnea, weakness, gastrointestinal and genitourinary symptoms, and terminally delirium and convulsions.

Dithiocarb (Na diethyldithiocarbamate trihydrate $(C_2H_5)_2N\text{-}\overset{\overset{S}{\|}}{C}\text{-}S\ Na \cdot 3H_2O$ was used in the treatment of 11 persons exposed to nickel carbonyl. Treatment of persons exposed to this agent consists of removing them from the exposure, and, if necessary, resuscitative measures similar to those used to treat carbon monoxide poisoning should be instituted. An eight-hour urine specimen is obtained immediately for analysis of its nickel content. Dithiocarb therapy (orally or parenterally, if necessary) may be instituted immediately if the exposure was heavy and typical symptoms appear. The upper normal limit of nickel in the urine is 3.0 μg per 100 ml. The exposure may be classed as mild if the concentration of nickel in the urine is less than 10 μg/100 ml, moderately severe if between 10 μg and 50 μg/100 ml, and severe, if above 50 μg/100 ml. In the latter class, the patients are apt to be seriously ill and require hospitalization. Patients who have had a moderately severe exposure may be given 0.5 gm of Dithiocarb three or four times daily together with 0.5 gm of sodium bicarbonate and a full glass of water. If a patient's condition is critical, it is suggested that Dithiocarb be administered parenterally in an initial dosage of 25 μg per kilogram of body weight and that the total amount during 24 hours be limited to 100 mg per kilogram of body weight. Persons who are receiving Dithiocarb should abstain from alcoholic beverages, since symptoms similar to those described after taking Antabuse have been reported. An illustrative case history is presented.

The Biological Effects of Vanadium: II. The Signs and Symptoms of Occupational Vanadium Exposure. C. E. Lewis.* A.M.A. Arch. Indust. Health 19:497 (May) 1959. (*Texas Eastman Co., Longview, Texas.)

Twenty-four men between 38 and 60 years of age who were exposed to vanadium at their work for at least six months (average duration of exposure was two and one-half years) were studied. A cough, often productive, was the most frequent symptom Burning of the eyes, rhinorrhea, and throat irritation were common complaints. Evidence of bronchospasm was present for two to three days after cessation of exposure to vanadium. Auscultation of the chest frequently revealed wheezes, fine rales, and rhonchi. Injection of the nasal mucosa and pharynx were common findings. A pale green to dark-greenish-black tongue ("green" tongue of vanadium workers) was observed in nine men. Evidence of chronic intoxication or injury attributable to exposure to vanadium in concentrations between 0.1 and 0.3 mg (with one exception) per cubic meter of air was not found.

Radiation Health

Thomas S. Ely, M.D.

Late Effects of X-Radiation: The Influence of Dose Fractionation on Life Span, Leukemia, and Renal Arteriolsclerosis Incidence in Mice. L. J. Cole, P. C. Nowell and J. S. Arnold. U. S. Naval Radiological Defense Laboratory, Research and Development Report USNRDL-TR-270: NM 62-03-60, OCDM. U. S. Naval Radiological Defense Laboratory, San Francisco.

About 240 female LAF_1 15-week old mice were randomized, divided into six approximately equal groups, and exposed to whole-body doses of 250 kvp x-rays as follows: 1. 690 r in a single dose (LD_{35}); 2. 690 r in a single dose followed by isologous spleen cells; 3. two doses of 348 r with an 8-week interval; 4. four doses of 174 r with 19-day intervals; 5. eight doses of 85 r with 8-day intervals; 6. nonirradiated controls. The total dose of each irradiated group

was about 690 r. The total interval of irradiation in all multiple dose groups was eight weeks. The animals were observed during their life span with no treatment. Among the irradiated mice fractionation of dose *increased* the incidence of leukemia.

The single-dose group had significantly less leukemia than the controls, posing the question of beneficial effect. Dose fractionation *decreased* the incidence of nephrosclerosis, the mice in Group 5 having normal incidence. All exposed groups suffered a decreased life span. This, too, was a function of dose rate (fractionation), with the greatest reduction occurring in Group 5. Hair graying was a function of dose rate in the opposite direction. No effect was seen in Group 5, whereas animals in Groups 1 and 2 became almost white.

Radiation Protection Laws and Codes—A Scramble for Action. W. A. McAdams.* Am. Indust. Hyg. A. J. 20:246 (June) 1959. (*General Electric Company, Schenectady, N.Y.)

Before the Atomic Energy Act of 1954, regulatory control was a tight federal monopoly. The act relinquished some federal control and spurred considerable state legislative activity. Since 1954, more than 250 state codes have been proposed, of which about 100 have been adopted. At the beginning of 1955, only California had a detailed code. By the end of 1958, eight states (California, Connecticut, Massachusetts, Michigan, Minnesota, New York, Pennsylvania, and Texas) had approved strong radiation protection codes. In addition, other states have special regulations, zoning and building codes, enabling legislation, and codes for the licensing or regulation of sources. Most have established study committees.

In developing legislation it is recommended that states (1) examine existing regulations—sometimes only minor changes would make good beginning radiation protection codes; (2) enforce developed rules; (3) enact clear, flexible codes that are not too specific; (4) wherever feasible, provide uniformity between states; and (5) follow the recommendations of the National Committee on Radiation Protection and Measurements.

Radioactive Decontamination Tests on Surgeon's Glove Contaminated with Plutonium. W. R. Kennedy* and J. B. Webber. Report No. LAMS-2117, May 20, 1957. (*Los Alamos Scientific Laboratory, Los Alamos, N. Mex.)

Plutonium-contaminated gloves were decontaminated with 24 commercial detergent solutions, a basic chelation solution, and an acidic chelation solution. The chelation solutions were definitely superior to the commercial detergents. However, a cost analysis showed that at least 50 cents worth of labor was required to decontaminate a 20-cent pair of gloves.

Health Aspects of Nuclear Technology. N. Wald.* A.M.A. Arch Indust. Health 19:345 (March) 1959. (*Department of Occupational Health, Graduate School of Public Health, University of Pittsburg)

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The atomic energy industry has shown no signs of slowing its rapid rate of expansion since its beginning, in 1942. The magnitude and complexity of this growth, in such fields as the provision of nuclear materials, production of reactors and components, operation of reactors, production of radioactive products, and utilization of radioactive products, have increased the potential contact with hazardous materials in the working environment. Nevertheless, the industry has had a good safety record, with both nuclear and nonnuclear hazards. The attitude toward safety with radiation hazards probably carries over into the area of conventional safety. The recent lowering of the recommended maximum permissible dose to an average of 5 rem per year will pose little hardship for the atomic energy industry, since in the past almost all exposures have been well below this figure.

Expansion of the industry is not likely to stop. More trained industrial health personnel and new and improved techniques and equipment for the diagnosis and treatment of radiation injury will be needed so that the good record can be continued.

Industrial Hygiene

Edward C. Riley, M.D.

Industrial Hygiene Experiences with Toluene Diisocyanate. H. T. Walwoth* and W. E. Virchow. Am. Indust. Hyg. A. J. 20:205 (June) 1959. (*American Cyanamid Company, Stamford, Conn.)

The recent increase in the use of polyurethane foams as a substitute for foam rubber as well as for a host of new applications has created an industrial hygiene problem of considerable magnitude. This paper concerns observations involving two principal industrial operations: (1) "the continuous production of a foam slab approximately 48 inches wide and 12 to 16 inches thick and (2) the production of molded products of varying sizes and shapes."

"The principal components of polyurethane chemicals are isocyanates and polyester or polyester resins. When these chemicals are brought together in the presence of water and a catalyst under proper conditions," polyurethane linkages are formed and carbon dioxide is produced, causing the resin to foam. During the mixing and pouring of this product a certain amount of diisocyanate vapor is given off, which can cause an asthmatic type bronchitis. There is little vapor released after the rising sets unless the foam is cut.

The study covers a period from October, 1955, to December, 1957, during which time vapor concentrations were determined in the production area. In addition, the plant physician kept track of the total incidence of illnesses thought to be related to polyurethane operations. In spite of the fact that

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average monthly concentrations of toluene diisocyanate (TDI) seldom exceeded 0.1 ppm, clinical cases continued to be observed.

"It was observed that most of the illnesses occurring among workers in the polyurethane departments appeared after three to four weeks of exposure to TDI." There was little direct correlation between the magnitude of TDI vapor exposure and the appearance of respiratory cases. "A downward trend in magnitude of TDI exposures and in the number of TDI cases has been shown."

An Investigation into the True Exposure of Arc Welders by Means of Simultaneous Sampling Procedures. W. S. Johnson.* Am. Indust. Hyg. A. J. 20:194 (June) 1959. (*Bethlehem Steel Company, Bethlehem, Pa.)

In this study on the job sampling of the welders exposure to Fe_2O_3 (iron oxide fume) was carried out by means of samples collected by electrostatic precipitators outside of the welders shield or helmet and by a filter sampling technique within the hood. After indicating that concentrations results are comparable for this type of fume. Johnson presents a table showing concentrations of welding fumes inside and outside the welder's hood. The ratio of the outside to inside concentrations vary from 1 to more than 7½, with an average of 3½ and a median of about 3.

"The results from this study show that the concentration of welding fume immediately outside of a welder's hood in the area normally sampled for measuring a welder's exposure is considerably higher than that in the air actually breathed by the welder."

Studies on Deposition of Submicronic Dust Particles in the Respiratory Tract. L. Dautrebande,* H. Beckmann, W. Walkenhorst. A.M.A. Arch. of Indust. Health 19:383 (April) 1959. (*64 Ave. Emile Duray, Brussels, Belgium)

"An experimental study of the lung deposition characteristics of four air-borne submicronic particles (India Ink, calcium carbonate, iron oxide, and aluminum powder) was undertaken on three normal human subjects breathing at three different rates: 3, 10, and 32 per minute with mean tidal volumes, respectively, of ca. 2,000, 800, and 350 cc. The mean size of the India Ink particles was ca. 0.1 and that of the other particles ca 0.2.

Based on the close analysis of the experimental data from this study, the authors conclude as follows: "The deposition rate of these submicronic particles in the lungs taken as a whole and in the last portion of the tidal air varies inversely with the respiratory rate.

"The deposition rate in these submicronic particles in the deep pulmonary regions, as represented by the Haldane-Priestly alveolar air, is not influenced by the respiratory rate.

"The alveolar deposition of these submicronic particles was regularly found to be very high (90% and more of the inhaled particles).

"Contrary to our previous findings with coal dust particles, we are not in a position to claim or to deny the existence of a minimum size deposition for each of the dusts presently studied.

"None of these findings appeared to be influenced by the number of particles present in the inspired air (from 15,000 to 400,000 per cubic centimeter)."

Dermatology

Leo J. Miedler, M.D.

Problems of Contact Dermatitis in the Atopic Individual. O. F. Jillson,* W. L. Curwen, and B. R. Alexander. Ann. Allergy 17:215 (March-April) 1959. (*Dartmouth Medical School, Hanover, N. H.)

Contact dermatitis in the atopic individual may be extremely perplexing. This report illumines the problem. Practical criteria are presented for the identification of the occult atopic individual. Physically there is one characteristic, an easily identifiable extra lower eyelid fold. Physiologically, there are two criteria. The first is the blanching noted a few minutes after the intradermal injection of acetylcholine into a region of involved skin. This response is in marked contrast to the expected physiologic reaction of vasodilatation or redness. The second is the blanching which occurs 15 to 30 minutes after the application of an ointment containing 5% of a nicotinic acid ester, Trafuril, to an involved area of skin. The usual reaction in the normal person is the production of erythema with or without edema in a similar time interval. After patch-testing with certain substances, localized, well-circumscribed intraepidermal vesiculation, periporal in location, is distinctive histopathologically. No single feature is invariably present or in itself diagnostic of the atopic state.

The criteria outlined were applied to 10 cases of contact dermatitis from neomycin and 6 cases with contact dermatitis from ragweed oil. Interestingly, all 16 patients were atopic. The authors postulate that neomycin and ragweed oil contact dermatitis are found almost exclusively in the atopic individual.

An Evaluation of a New Cerumenolytic Agent. J. Q. Gant Jr.* A.M.A. Arch. Dermat. 79:651 (June) 1959. (*Skin and Allergy Clinics, Regional Office of the Veterans Administration, Washington, D. C.)

The safe and effective removal of wax from the ear can sometimes constitute quite a problem. James Q. Gant introduces us to Cerumenex, a surface-active agent chemically consisting of a triethanolamine polypeptide oleate condensate in propylene glycol with chlorobutanol. Cerumen is composed of two elements: a fatty and tenacious substance secreted by the sebaceous glands and a thin secretion of the apocrine glands. The latter serves to dilute the heavy sebaceous material and

produce a soft, malleable wax. However, for a variety of reasons, cerumen may be retained, thus leading to a multiplicity of symptoms. Among these are decreased hearing ability, vertigo, tinnitus, and pain. Often attendant irritation can initiate an itch-scratch cycle. This may, in turn, directly produce the otitis externa syndrome. One hundred sixty-three patients with excessive deposits of ear wax were the subjects of this investigation of the new cerumenolytic. In 142 patients removal of the wax was complete; in 18 patients most of the wax was removed; and in 3 patients the wax refused to yield. Untoward side-effects were not noted. Ten of the patients tested for sensitivity over a period of six weeks developed no evidence of irritation or allergic sensitization.

Peripilar Keratin Casts. M. J. Scott.* A.M.A. Arch. Dermat. 79:654 (June) 1959. (*Medical and Dental Building, Seattle, Wash.)

Peripilar keratin casts, also known as hair casts and pseudoparasites of the scalp hair, are characterized by asymptomatic, small, semifirm, freely movable, tannish, cylindrical masses distributed along the scalp hair. Scott reports three cases in sisters aged 4, 6, and 7 years and one case in a 46-year-old woman. Clinically, the diagnostic features are the tubular shape of the casts and the free movability along the hair shaft. These characteristics serve to differentiate the disease under discussion from the nits of pediculosis capitis. For the sake of completeness there are also a number of less-well-known entities of peculiar interest to dermatologists. Examples are tricorrhexis nodosa, monilethrix, and trichonodosis. Although the causation of hair casts is not known, the author provides circumstantial evidence implicating hair sprays in his cases.

NOTE: This condition is probably of much higher incidence than usually appreciated. It has been the subject of two other recent reports.

Poison Ivy Dermatitis. R. J. Langs,* A. M. Fuchs, and M. B. Strauss. Indust. Med. & Surg. 28:257 (June) 1959. (*Albert Einstein College of Medicine, New York.)

An alum-precipitated pyridine ivy complex known as Aqua Ivy was used throughout this study. Sixteen subjects, ivy-sensitive by history and patch test, received a course of prophylactic treatment for approximately three months. Immediately after treatment was completed, all subjects displayed some degree of hyposensitization as measured by patch testing. Eight became patch-negative. Repeat patch tests, 6 and 12 months after completion of tablet ingestion, likewise demonstrated that patch test hyposensitization had been maintained. Forty-two adults and twenty-six children with a past history of poison ivy dermatitis and relatively frequent exposure to the plant also received varying amounts of prophylactic therapy from 10 physicians. The incidence of poison ivy dermatitis in this group was 3%. Side-effects were minimal. Toxicity studies in animals and humans were negative.

NOTE: For an excellent summary of the opposition view, refer to "Hyposensitization Against Rhus Dermatitis," by A. M. Kligman, *A. M. A. Arch. Dermat.* 78:47 (July) 1958.

Venereal Diseases Today. N. J. Fiumara,* B. Appel, W. Hill, and H. Mescon. New England J. Med. 260:863 (April 23) and 9:7 (April 30) 1959. (*Massachusetts Department of Public Health, Division of Venereal Diseases, Boston.)

The authors present an excellent analysis of public health progress and the over-all problem of venereal disease and then proceed to a consideration of the two major diseases, gonorrhea and syphilis. The discussion includes a succinct presentation of the clinical picture, testing procedures, and treatment of the conditions. The problems of treatment-resistant gonorrhea and patient sensitivity to penicillin are included in the review.

Experimental Toxicology

R. E. Eckardt, M.D.

Physiological Effects of Chronic Exposure to Carbon Monoxide. S. S. Wilks, J. F. Tomashefski, and R. T. Clark, Jr. J. Applied Physiol. 14:305 (May) 1959.

Dogs exposed daily to CO-air mixtures of 0.08-0.10% CO for 36 weeks demonstrated increased tolerance to CO when compared with normal controls. The observed increased tolerance to CO was attributed to the increase in concentration of hemoglobin pigments of the blood which made a greater reserve of hemoglobin for transporting oxygen at a given concentration level of HbCO. Animals subjected to other hypoxic stress, such as altitude, or normal animals transfused to increase the red blood cell concentration showed increased tolerance also.

The Penetration of Bromine into Cells of the Central Nervous System. V. E. Maevskii* and P. I. Berenskii. Pharmacol. & Toxicol. 21:374-5 July-Aug. 1958. (*A.M. Gor'kii Stalinsk State M. Inst., U.S.S.R.)

Radioactive bromine was injected subcutaneously into dogs. The brain was removed one and one-half hours later. No bromine was found in the nuclei of nerve cells from gray matter. Pronounced radioactivity was found in certain segments of nerve fibers from white matter. It is concluded that bromine, like chlorine, is present in brain tissue in the intercellular fluid.

N-Acetyl-dl-Penicillamine, A New Oral Protective Agent against the Lethal Effects of Mercuric Chloride. H. V. Aposhian* and M. M. Aposhian. J. Pharmacol. & Toxicol. 126:131 (June) 1959. (*Vanderbilt University School of Medicine, Nashville, Tenn.)

Data are presented on the protective effect in rats of varying amounts of N-acetyl-*dl*-penicillamine administered orally at —2,0,+4,+24, +48, and

+72 hours after the intraperitoneal injection of 3 mg/kg of mercuric chloride. It was also found that predosing two hours before $HgCl_2$ injection was not necessary for protection. Similar data on other sulfhydryl compounds (*d*-penicillamine; *dl*-penicillamine, and *dl*-cysteine) which were less effective, are presented for comparison. Acute oral and intraperitoneal toxicity data presented for *dl*-penicillamine and acute oral data for *d*-penicillamine and *N*-acetyl-*dl*-penicillamine indicate the latter two to be less toxic than the former.

Vapor Toxicity of Allyl Chloride as Determined on Laboratory Animals. T. R. Torkelson,* M. A. Wolf, F. Oyen, and V. K. Rowe. Am. Indust. Hyg. A. J. 20:217 (June) 1959. (*Dow Chemical Co., Midland, Mich.)

Rats, guinea pigs, and rabbits exposed seven hours daily for one month to 8 ppm allyl chloride vapor in air exhibited definite liver and kidney damage. These species and dogs tolerated similar exposures to 3 ppm for six months with only slight reversible liver damage seen in female rats. An MAC for man of 2 ppm is suggested for repeated exposures, with the proviso that the time-weighted average for all exposures not exceed 1 ppm. The odor threshold limit is about 3 ppm, thus, odor cannot be used to warn against excessive concentrations for prolonged repeated exposures. Prevention of all contact by use of closed systems, respiratory tract and eye protection, and protective clothing is recommended.

Vapor Toxicity of Allyl Alcohol as Determined on Laboratory Animals. T. R. Torkelson,* M. A. Wolf, F. Oyen, and V. K. Rowe. Am. Indust. Hyg. A. J. 20:224 (June) 1959. (*Dow Chemical Co., Midland, Mich.)

Rats, guinea pigs, and rabbits exhibited slight micropathological changes in the liver and kidney after five weeks of daily seven-hour exposures to 7 ppm allyl alcohol vapor in air. No detectable injury was seen in these species or in dogs exposed similarly to 2 ppm for six months. An MAC for man of 5 ppm is recommended for repeated exposures, provided the time-weighted average for all exposures does not exceed 2 ppm. The odor is detectable at 5 ppm but cannot be relied upon for control purposes. Prevention of all contact is recommended, by the use of closed systems, respiratory tract and eye protection and protective clothing.

Oil of Sweet Orange: A Possible Role in Carcinogenesis. F. J. C. Roe.* Brit. J. Cancer 13:92 (March) 1959. (*London Hospital Medical College.)

A preliminary note reports the induction after 24 weeks of many skin papillomas and one subcutaneous hemangioma in "101" strain mice treated once with 300 μg of 9,10-dimethyl-1,2-benzanthracene (DMBA) in 0.2 ml of acetone, followed in three weeks by once weekly applications of 0.25 ml. of oil of sweet orange (mainly composed of limonene and decanal). The addition of urethane to the oil slightly increased the yield of tumors. Mice treated with DMBA alone or oil of orange alone developed no tumors during the same period. The significance of these observations is not discussed.

Physiological Study of the Summating Effects of Ethyl Alcohol and Carbon Monoxide. L. J. Pecora.* Am. Indust. Hyg. A. J. 20:235 (June) 1959. (*Public Health Service, Occupational Health Field Headquarters, Cincinnati.)

No significant summating effects of ethyl alcohol and carbon monoxide were noted in dogs maintained at a blood alcohol level of about 0.15% during the daily exposure of 100 ppm of CO for six hours a day, five days a week for 21 weeks. The level of HbCO reached 18-20% after several hours of exposure. The amount of alcohol administered daily is said to be equivalent to about 2 pints of table wine or 8 bottles of beer. Control groups were given equivalent doses of alcohol or exposed to equivalent concentrations of CO only. Measurement of various functions and histological study of tissues were made. Two observations warrant further study: a lower average HbCO in the alcohol-CO group and marked decrease in total lipoprotein in the CO group, based on a single electrophoretic assay of serum protein and lipoprotein. It is emphasized that an imposed work load might alter the responses noted in this study.

Effects of Environmental Temperature on the Acute Toxicity of a Number of Compounds in Rats. M. L. Keplinger,* G. E. Lanier, and W. B. Deichmann. Toxicol. & Applied Pharmacol. 1:156 (March)) 1959. (*University of Miami School of Medicine, Coral Gables, Fla.

The acute intraperitoneal toxicity of 58 compounds was determined in rats exposed to 80°, 26°, and 36° C. environments in which relative humidities were kept constant. All but three were most toxic at 36°; strychnine was equally toxic at 8° and 36°; promazine and chlorpromazine were most toxic at 8°. Theories on the mechanisms involved in the observed effects of environmental temperature on toxicity are presented.

Lesions of the Nervous System Secondary to the Ingestion of Diethyltin. J. E. Gruner. 98:109, 1958; Chem. Abst. 53:3475h (Feb. 25) 1959.

Lesions in humans and experimental animals are identical. Characteristic findings are tumefaction of the cerebral hemispheres, with swelling and edema of white matter, with swollen (oligocytes) and degenerated astrocytes, recent hemorrhages, vasodilatation, and congestion. The neurons show few changes, mostly secondary to axon changes.

The Safety of Polyoxyethylene Stearate for Use in Foods. National Res. Council Food Protection Comm. Publ. No. 646, 1958. (Washington, D. C.)

A review is presented of information on the properties, uses, and toxicity of polyoxyethylene stearates, with the conclusion that their use as emulsifying agents in the human diet at levels not greater than 0.05% would be safe.

About the Authors

FRANCIS C. DOHAN, M.D., trained as an internist with subspecialty interest in endocrinology, became Medical Director, Radio Corporation of America at Camden, N. J., in 1952. He was soon intrigued by the variations in time lost by employees following surgical procedures and forthwith began to study the problem himself and to interest others in it. A product of this interest and work is the symposium which was presented at the Atlantic City Meeting of the Industrial Medical Association in 1958 and published in this issue. An earlier result was the Conference on Surgical Convalescence, which was co-sponsored by the New York Academy of Sciences and the American College of Surgeons.

DR. DOHAN accomplished his premedical studies at Haverford College and attended the University of Pennsylvania School of Medicine. After a residency in medicine at Massachusetts General Hospital he returned to the University of Pennsylvania to serve successively as instructor in pharmacology, instructor in medicine, Fellow in the George S. Cox Medical Research Institute, assistant professor of clinical medicine, and Chief of the Endocrine Section of Pepper Laboratory. He was on active duty in the Army from 1942 to December, 1945, first in the African Theatre, and later with the Ferrying Division of Army Transport Command. He was discharged as a major and a qualified flight surgeon.

In the time which remains over from his duties with R.C.A., DR. DOHAN now conducts research in endocrinology, serves as a consultant to the Army and to the Veterans Administration, and carries on a private practice in the specialty of endocrinology.

HARVEY SAFFEIR was graduated from Cornell University in 1951 and has been employed by The Travelers Insurance Company, Inc., ever since. He holds the position of Assistant Actuary in this firm and is a Fellow of the Society of Actuaries. He handles premium rate determinations for group accident and sickness insurance. He is the author of the article in this issue entitled "The Duration of Surgical Convalescence as Indicated by Insurance Statistics." He has addressed the American College of Surgeons on a similar topic.

DR. SIDNEY PELL is the author of the article in this issue entitled "Electronic Processing of Industrial Medical Data with Special Reference to Surgical Convalescence Statistics." There have been other articles by Dr. Pell which are more representative of his activities as biostatistician in the Medical Division of E. I. du Pont de Nemours & Company. These deal with basic contributions to the understanding of medical problems, as this understanding might be developed from a constant study of the records and reports of that company's very large Medical Division. His current studies range over a list of topics: diabetes, effect of noise on hearing acuity, ABO blood groups and disease, and the epidemiology of cardiovascular disease. These make use of the circumstances that clinical examinations of uniform quality are made of a definable population, that records are made of the sickness and health experience of this population, and that the population is stable and "captive" in the epidemiologist's sense of the word.

DR. PELL received a bachelor's and a master's degree from City College of New York, after which he was a statistician at New York University-Bellevue Medical Center, New York. He was then recipient of a doctoral fellowship in the Department of Biostatistics, Graduate School of Public Health, University of Pittsburgh, from which institution he recevied the Ph.D. degree in 1956.

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About the Authors

N. HENRY MOSS, M.D., although actively engaged in cancer surgery and research in this subject, has a wide interest in surgery which provides the background for his article in this issue entitled "Current Concepts Concerning Surgical Convalescence."

An Honor Man at Central High School of Philadelphia, Dr. Moss entered Princeton University and then the University of Pennsylvania School of Medicine, from which institution he received the M.D. degree in 1948. After an internship at the Hospital of the University of Pennsylvania DR. MOSS entered upon a series of appointments as resident, instructor, and research assistant in surgery at that institution. He served two years as a base hospital surgeon in the Air Force during 1951-1952.

DR. MOSS'S publications deal predominantly with surgical and chemotherapeutic procedures useful in malignant disease, and secondarily with the topic of his paper in our present issue. He holds hospital appointments in surgery at the Hospital of the University of Pennsylvania and Albert Einstein Medical Center, and is an instructor in surgery both at the University of Pennsylvania and at the Temple University Medical School. He is a specialist certified by the American Board of Surgery and an Associate member of the Industrial Medical Association.

NORVIN C. KIEFER, M.D., is author of the special report in this issue on the 1959 National Health Forum whose topic was "The Health of People Who Work." Dr. Kiefer was President of the National Health Council, 1958-1959 and was thus intimately concerned with this year's Forum. His summary of the high points carries the insight that can develop only in the holder of the triple role of planner, participant, and observer in an operation as big as was this year's Forum.

DR. KIEFER, a native of Ohio, attended Western Reserve University and the University of Michigan, from which institution he received the M.D. degree in 1930. After training, he carried on a private practice in internal medicine in Geneva, Ohio, until 1945, when he became a commissioned officer of the U.S. Public Health Service, assigned to the Tuberculosis Control Division. After the war, a year of study at the Johns Hopkins School of Hygiene and Public Health lead to the Master of Public Health degree. There followed four years of service with agencies in Washington, notably the National Security Resources Board and the Federal Civil Defense Administration.

DR. KIEFER was appointed Chief Medical Director of the Equitable Life Assurance Society of the United States on Aug. 1, 1953. In that capacity

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he has charge of all medical activities of the Equitable, including medical selection of risks and life insurance medical examinations, the Equitable's employees' health program, public health and health education activities, industrial health services, and the Society's diagnostic and chemical laboratories and medical research work. Dr. Kiefer is certified as a specialist by the American Board of Preventive Medicine.

JONATHAN W. WILLIAMS, PH.D., is Assistant Director of the Du Pont Company's Haskell Laboratory for Toxicology and Industrial Medicine. He received his undergraduate training at Baldwin-Wallace College and his master's and doctor's degrees from Northwestern University, receiving the doctoral degree in 1935. The six years following graduate school were spent in college instruction in organic chemistry. He was a member of the Chemistry Department staff, first at the University of Maryland and then at the University of North Carolina. In 1941 he went to the U. S. Naval Research Laboratory, where he helped to organize the research unit in Chemical Warfare Defense. From 1942 through 1945, he served as Senior Technical Aide in the Division of Chemistry of the National Defense Research Committee. Joining Du Pont in 1946, he was first a Research Supervisor in biochemical research for the Grasselli Chemicals Department, and in 1950 he became Manager of that department's Biochemicals Research Section. In 1954 he assumed his present position at Haskell Laboratory. He is a member of the American Chemical Society and the American Industrial Hygiene Association, and is the author of some 20 technical papers and patents.

MORTIMER B. HELLER, M.S. (Hyg.) is Health Physicist, the University of Pittsburgh. He is senior author of the topical review in this issue, "Fundamentals of Nuclear Physics," the third in our series, "Industrial Medical Aspects of Nuclear Technology."

MR. HELLER is a native of New York. He received the A.B. degree from Champlain College in 1952 and thereafter served as a corporal in the Army for two years. He then worked as research assistant in the carcinogenesis laboratory in the Department of Occupational Health at Pittsburgh for two years. In the period 1955-1957 he was a health physicist at Brookhaven National Laboratories, where he was responsible for the health physics activities in the medicine and biology departments. MR. HELLER returned to Pittsburgh in 1957 as a graduate student, with an Atomic Energy Commission Fellowship in Industrial Hygiene. For his master's degree thesis he completed a segment of a long-term study in which he continues to be active, phagocytosis of radioactive barium sulfate particulates.

A formal health physics program for the University of Pittsburgh was organized in 1958, and since its beginning has been operated by MR. HELLER. He is a member of Sigma Xi, American Industrial Hygiene Association, Health Physics Society, and American College Health Association.

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*Peck, S. M., and others: A.M.A. Arch. Dermat. and Syph. 67:263, 1953.

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People and Events

► GEORGE H. GEHRMANN, M.D., retired Medical Director of the E. I. du Pont de Nemours and Company, died September 3 at his home in Fairville, Penna., after a lengthy illness. He was 68 years old.

DR. GEHRMANN received his M.D. degree from Long Island Medical School in 1913 and interned at the Long Island College Hospital. He started with Du Pont in 1915 and became head of the Medical Division in 1926, a position he held until his retirement in 1955. He is credited with developing the company's medical unit into one of the largest and most complete in the country. DR. GEHRMANN was a pioneer in such preventive medical work as annual physical examinations for all employees. His work in industrial psychiatry and the control of alcoholism is well known to those in the field of industrial medicine.

In 1955, DR. GEHRMANN received the Industrial Medical Association's Knudsen Award. That same year, the American Academy of Occupational Medicine established the annual "George H. Gehrmann Lectureship" honoring him for his "many outstanding contributions" to the field. DR. GEHRMANN was a founder of the Academy and served as its first president. He was a Fellow of the Industrial Medical Association, the American College of Physicians, the American Medical Association, and the American Public Health Association.

► MAX RONALD BURNELL, M.D., who retired as Medical Director of General Motors Corporation last year, died September 19 in Flint, Michigan at the age of 65.

DR. BURNELL graduated from the University of Michigan Medical School in 1918 and interned at Long Island College Hospital from 1918-21. He did postgraduate work in Vienna and returned to Flint to begin medical practice as an obstetrician and gynecologist.

In 1931, he joined GM as Medical Director of the A-C Spark Plug Division. In 1949 he became Medical Director of GMC.

DR. BURNELL was a Fellow of the Industrial Medical Association and the American College of Surgeons. He was certified in occupational medicine by the American Board of Preventive Medicine.

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Denver on September 9 by approximately 30 industrial physicians representing Colorado, Montana, Nevada, New Mexico, Utah, Wyoming, western Nebraska and western South Dakota. This group was organized with the intention of eventually becoming a component society of the Industrial Medical Association.

Officers and a Board of Directors were elected to serve an interim term of one year to organize on a permanent basis. The officers are: LEWIS C. BENESH, M.D., President; J. FREDRIC PRINZING, M.D., Vice President; IRVING OHR, M.D., Secretary; and JAMES W. MONSOUR, M.D., Treasurer. Elected to the Board of Directors are: LEWIS OVERTON, M.D.; ROSCOE REEVE, M.D., R. B. RICHARDSON, M.D.; HAROLD C. JENKINS, M.D.; N. WELLS STEWART, M.D.; W. W. WEBSTER, M.D.; WILLIAM BOEHM, M.D., and JAMES ARNSILL, M.D.

LOUIS RETTALICK, M.D., was named chairman of the Nominating Committee, and ROSCOE REEVE, M.D.; R. B. RICHARDSON, M.D.; By-Laws Committee.

► The Occupational Health Section of the American Public Health Association will hold its annual symposium on October 20, during the 87th annual meeting of the APHA in Atlantic City, October 19-23. The Industrial Medical Association and the American Industrial Hygiene Association are cosponsors of the symposium.

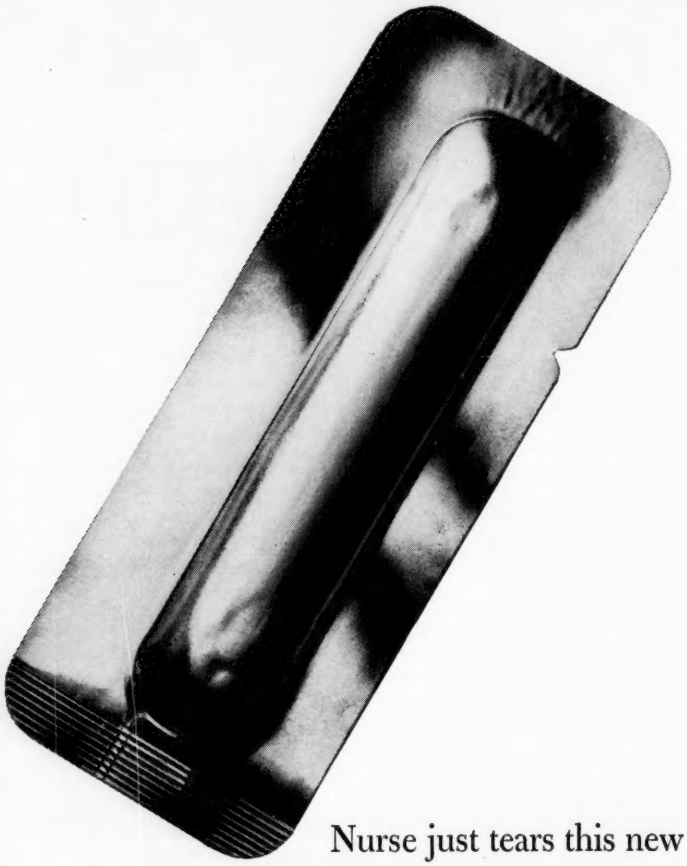
The theme of the morning session will be "Women in Industry." LEWIS J. CRALLEY, Ph.D., will preside. Speakers and their presentations will be: "Who Are the Women in Industry?"—AUGUSTA H. CLAWSON, M.A.; "The Relationship Between Symptoms, Disability, and Serious Illness in a Random Sample of Working Women"—LAWRENCE E. HINKLE, JR., M.D., and NORMAN PLUMMER, M.D.; "Gynecological Problems: Their Effect on the Working Woman"—LUELLA E. NADELHOFFER, M.D. The chairman of the panel discussion will be ANNA M. BAETJER, Sc.D.

An address scheduled for the luncheon session, entitled "Developments in Industrial Medicine in Japan," will be presented by MASAYOSHI YAMAGUCHI, M.D.

The afternoon program is entitled "Carcinogenesis—Environmental Factors." SEWARD E. MILLER, M.D., will preside, and the following papers will be presented: "Occupations and Lung Cancer"—LESTER BRESLOW, M.D., JOHN E. DUNN, JR., M.D. and GEORGE LINDEN; "Status of Experimental Induction of Cancer"—ROBERT E. ECKARDT, M.D.; "Current Status of Bladder Carcinogens"—speaker to be announced. THOMAS F. MANCUSO, M.D., will be chairman of the discussion panel.

► Western New York Society of Industrial Medicine and Surgery will hold its fall meeting at The Treadway Inn in Niagara Falls on October 17. The scientific program includes four addresses as follows: "Use and Abuse of Steroids in the Treatment of Common Skin Diseases" by HERBERT L. TRAENKLE, M.D.; "Eye Problems in Pre-employment and Placement Examinations" by W. YERBY JONES, M.D.; "Vascular Diseases and Their Relation to Employability" by JAY I. EVANS, M.D., EVERETT H. WESP, M.D., and ROBERT H. MEHNERT, M.D.; "Certain Aspects of Collagen Disease as Related to Industrial Medicine" by GEORGE L. COLLINS, JR., M.D.

► The New York State Association of Industrial Nurses will hold its 8th annual health conference in New York City on November 6-8, at the Commodore Hotel. Elizabeth Van Steenburgh, R.N., Johns-Manville, is Conference Chairman.



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► The first Occupational Health Seminar ever convened in the Republic of Colombia, South America, was held in Bogotá June 22-27. It was organized by the Department of Occupational Health of the Colombian Ministry of Public Health under the management of ROBERTO ACOSTA, M.D., Director.

All sessions were held in the principal lecture hall of the School of Chemistry and Chemical Engineering of the National University. Some 200 persons were in attendance, including medical directors and safety supervisors of important Colombian industries, as well as representatives of other governmental agencies concerned with worker health.

The purpose of the meeting as stated on the official program was "to serve as a source of training for those interested in occupational health. It is intended to enlighten physicians, engineers, chemists, nurses, and all those persons that are engaged in whatever aspect of occupational health, and to awaken in them a greater appreciation of the importance and value of applying the principals of public health to the preservation and promotion of the health and welfare of the workers."

Featured guest speakers from the United States were HARRIET L. HARDY, M.D., Associate Physician in charge of Occupational Medical Clinic, Massachusetts General Hospital, Boston; DONALD J. BIRMINGHAM, M.D., Chief Dermatologist, U.S. Public Health Service; and THEODORE HATCH, Professor of Occupational Health Engineering, Gradaute School of Public Health, University of Pittsburgh.

DR. HARDY'S lecture on the pneumoconioses was amply illustrated with 27 projected radiographs and case histories from all over the world. An informative lecture on occupational skin diseases presented by DR. BIRMINGHAM was also accompanied by projected illustrations. The adaptation of engineering to the explanation of the mechanism of the causation of an occupational disease was the subject covered by PROFESSOR HATCH. A half day was dedicated to each of these topics.

The other seminar speakers and their subjects were as follows: "Occupational Medicine—Medico Economic Consideration" by DR. DOMINGO VARGAS, Medical Director, Esso Colombia; "Present Day Colombian Industry" by MARION F. TRICE, International Cooperation Administration (ICA) industrial hygiene consultant to the Colombian Ministry of Public Health; "The Background of Occupational Health in the Colombian Ministry of Public Health" by J. J. BLOOMFIELD, ICA Regional industrial hygiene consultant; "Industrial Sociology" by PROFESSOR JOHN B. KNOX, University of Tennessee; "Protection Against Ionizing Radiations in Diagnosis and Therapy" by DR. MARIO GAITAN-YANGUAS, Director, National Cancer Institute; "Personnel Dangers in the Use of Radioisotopes" by DR. JAIME CORTAZAR, Chief, Radioisotope Section, National Cancer Institute; "Industrial Hygiene in Brazil" by MARIO STORLAZZI, ICA industrial hygiene consultant to the Brazilian Ministry of Public Health; "Occupational Health Chemistry" by A. S. LANDRY, ICA regional adviser in chemistry, Lima, Peru; "Industrial Dentistry" by DR. ARTURO OCAMPO, Public Health Dentist, Colombian Ministry of Public Health.

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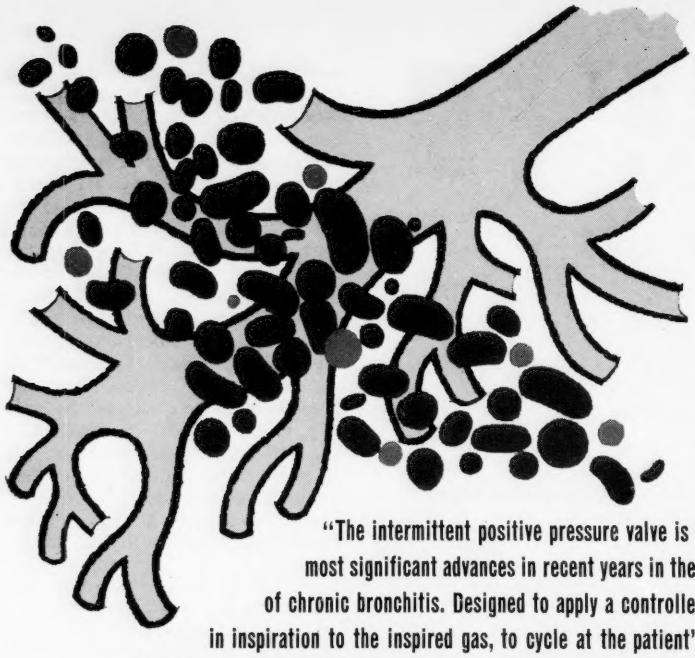

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– Farber, S. M.; Wilson, R. H. L., and Smith, J. D.; California M. 84:101 (Feb.) 1956

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